ESSENTIALS
OF
HYGIENE AND PUBLIC HEALTH
(WITH UNIVERSITY QUESTION PAPERS)

SANTI LAL ROY

Author of
"Essentials of Ophthalmology"
"Essentials of the diseases of E.N.T,"
"Essentials of Fractures: Splints; dislocations; deformities Etc."

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CONTENTS

CHAPTER ONE

PUBLIC HEALTH ADMINISTRATION

Def:—The public health administration is the science of organising and operating governmental agencies to improve the physical wellbeing of general population and aims at promotion of health and prevention of diseases of the community based upon the fundamental needs of human welfare.

Organisation:—The whole public health administration underwent a new orientation in giving effect to the recommendations made by the Health Survey and development committee, popularly known as the Bhore Committee in their report published in 1946. The present government is ready to follow the scheme which though not functioning in toto at present has been adopted with certain modifications suiting to local conditions.

The present public health administration can be said in general to consist of the following:—

(A) *Ministry of Health in the Centre*:—This is under the charge of an elected minister having at his or her command the technical services of D.G.H.S. (Director General of Health Services) who also acts as a Secretary to the ministry of health. The ministry of health is also helped from time to time by a statutory "Central board of Health" for the purpose of Co-ordination and to provide a forum for collective deliberations of common health matters. This Committee consists of the Minister of health at the Centre as chairman D.G.H.S. as Secretary, the provincial ministers of health and Directors of health service as members. The main functions of the central ministry are:—

(1) To study and plan schemes of health services, both preventive and curative for the whole of India.

(2) To provide for the Medical research and training of the research personnel.

(3) To collect, tabulate and publish vital statistics, Periodical Census etc.

(4) To establish and enforce standards of control for manufacture and sale of drugs and biological products.

(5) To control international spread of communicable diseases, and to fulfil international obligations.

(B) *The Provincial Ministry of Health*:—Is in the hands of an elected Minister who has at his command the technical services of D.H.S. (Director of Health Services). The D.H.S. is the administrative head of the Medical and public health department and also acts as a Secretary to the Local Self Govt. Medical Branch. The D.H.S. is assisted by several Deputy and asst. Directors.

The main functions of the provincial ministry are:—

(1) To study provincial health problems, to plan schemes for their solution.

(2) To provide for medical education and training of medical and auxiliary personnel.

(3) To collect, tabulate and publish vital statistics of the province.

(4) To maintain a Laboratory for chemical and sanitary examinaitons.

Under the provincial ministry of Health comes the Local area Health administration, popularly known as "RURAL HEALTH SCHEME".

The RURAL HEALTH SCHEME is split up into the following:—

(1) *Union Health Centre*:—One health Centre in each of the unions of West Bengal. Each union health centre will comprise of one M.O., one Compounder, one Health assistant and a Dai. Each of these will be 10 bedded.

(2) *Thana Health Centres*:—One centre in each Thana comprising of two M.O.'s, Health Inspector, Health Visitor, compounder and other staff. Each centre will be 30-50 bedded according to local requirement and would include a Bullock Cart ambulance to carry patients from union health centres.

In these union and Thana centres. M.O. Sanitary Inspectors, health assistant etc. besides giving medical relief should also do preventive health work by visiting homes, looking after school children, taking care of maternity and child welfare centres, dealing with important preventible diseases like malaria, Tuberculosis, Cholera, Leprosy, V. D. etc.

(3) *Subdivisional Health Centres*:—Each subdivision will be provided with 50-200 bedded hospital with necessary staff including special departments like, Eye, Ear, Nose and Throat, V.D. X'Ray Dept. etc. Each centre will be provided with an ambulance.

(4) *District Health Centres*:—Are to be located in each district headquarters by improvement and expansion of the existing state managed district hospitals with an accommodation of 200 to 500 beds. Two of these district hospitals in the province are proposed to be provided with specialist staff and equipments to serve as Regional hospitals having a specialist personnel and all facilities for all kinds of special treatment.

Each District Health centre would comprise of District administrative medical officer with a Deputy; an assistant health engineer to look after housing, sanitary arrangements etc. Senior sanitary inspectors and public health nurses to be attached here for inspection of the thana centres. The hospital organisation will be run by a Superintendent.

In addition to above health centres, a number of maternity and child welfare centres, Anti tuberculosis clinics, V.D. clinics etc are proposed to be established in suitable places besides those attached to the subdivisional and District Health Centres. These centres and clinics are also to be attached to each Institution where medical education and training for auxillary personnel required for the health centres are given.

Besides above, Impersonal health services like Town planning, housing, water supply, drainage and other matters regarding general sanitation under a public health engineer will also be provided under this Health plan.

N. B. After the 1st world war Health section under the League of Nations took up the work of international coordination of health measures and tried to solve many a health problem. After the 2nd world war the same functions but in a more comprehensive scale has been taken over by the U.N.O. (United Nations organisation). A world health organisation (W.H.O.) has been set up with representatives from all the countries. W.H.O. is trying to solve many a health problem through its numerous associations, committees etc. Such as Tuberculosis, V.D. maternity and child welfare etc.

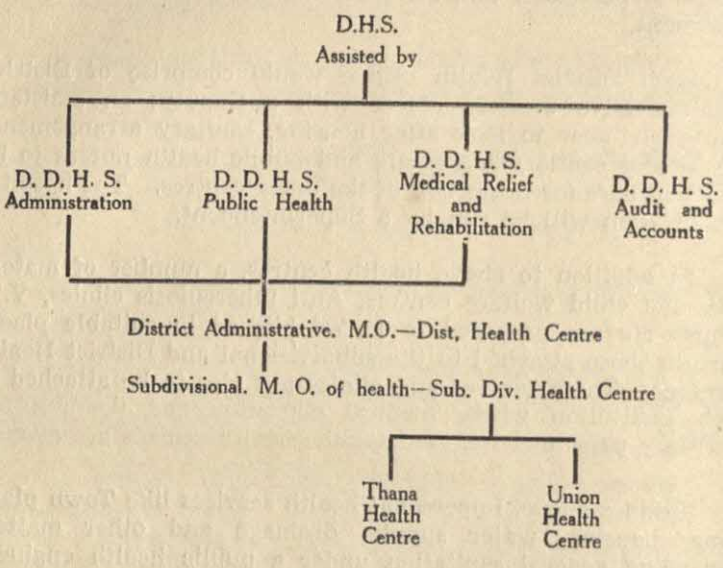
Summary:—The public health administration in Bengal can be summarised as follows:—

Ministry of Health

(Under the Minister in charge of Local Self Govt. and public health).

Health Department

(Under Director of Health Services-who also acts as a Secy. to public health and medical Dept. under L.S.G.)



District Health Centre
200—500 beds .. (1) District Administrative. M.C. of health.

(2) Deputy Administrative. M.O. of health.

(3) M.O. for maternity child welfare, V.D., T.B., Leprosy clinics, etc.

(4) Asst. Public Health Engineer for general sanitation, housing, drainage, etc.

(5) Senior Sanitary Inspectors, public health nurses to inspect Thana and Union Health Centres.

		(6) Specialist staff.
		(7) Other staffs.
Sub-divisional Health Centre 50—200 beds	..	Sub-divisional M.O. of health and other staff.
Thana Health Centre .. 30—50 beds	..	Rural M.O. of health Compounder. Health Inspector. Health Visitors. Health Asst. Midwife. Menial staff.
Union Health Centre .. 4—10 beds	..	M.O. Compounder. Health Asst. Dai.

Explanatory Note:

To provide co-ordinated medical and public health services, to the people in the countryside, the Government of West Bengal have adopted a comprehensive scheme for providing medical relief facilities and enforcing preventive measures in matters of public health. One health centre is to be established in each of its 2,079 unions and a health centre is to be started at the headquarters of each thana. Each centre will have 20 beds with an adequate public health staff, lady health visitors and midwives. These health centres not only treat patients who come to the clinics and provide beds for those who need them but from them, workers visit the villages regularly and talk to the people on matters of health, nutrition and other factors associated with the promotion of healthy living in the villages. Health assistants also go round the villages, collecting vital statistics and inoculating people with preventive vaccines. The medical officer of the health centre also tours the villages accompanied by a medicine-carrier. He examines patients, gives them medicine free of cost, holds regular meetings in the villages where he speaks on a better mode of living.

One hundred and seventy-six such health centres have already been opened in the villages. One hundred more centres are in the process of construction and are expected to be completed before the current financial year ends.

Besides these health centres, there are 211 mobile medical units which are posted in the districts of West Bengal according to the needs of the rural population. They go to the countryside, mostly in the remote areas where no other medical aid is readily available. These medical officers run 613 centres and cater to the needs of nearly 2,500 villages; each unit attends to about 600 patients per month.

In cases of outbreak of epidemic or unnatural calamity, these mobile medical units are drafted to the distressed areas to render medical aid.

Two hundred and sixty-four village dispansaries run by the Union Boards and 41 thana dispensaries are given grants-in-aid and supplied with free quinine all the year round. There are 102 auxiliary general hospitals in the State. These are the legacies of the famine conditions when these institutions were started as a temporary measure in 1943-44. These are gradually being replaced by permanent health centres.

The hospitals which were under the charge of the local bodies in the districts and subdivisional headquarters have been taken over by the Government. These are gradually being upgraded by the addition of more beds and other facilities for modern treatment.

To improve maternal benefits 2,715 beds have been opened in the mofussil during the last four years for labour cases. The health centres also have maternity wings. There are 39 maternity and child welfare centres now operating in the different parts of this State. Attempts are in progress to add to their number with the active co-operation of the people.

The dearth of qualified midwives has been keenly felt, particularly in the villages. To tide over this deficiency in auxiliary personnel, an elaborate scheme has been adopted by the Government of West Bengal to train 200 midwives each year at Singur and at the Fraser Hospital, Burdwan. These midwives will use bicycles to carry them about their "parishes."

The Indian Red Cross Society have opened several maternity homes in the countryside to augment Government measures through the maternity and child welfare centres. Ante and post-natal work by lady health visitors is regularly done, with the assistance of UNICEF free milk powder is distributed to expectant mothers and growing children.

CHAPTER TWO

WATER

Physical Properties:—Water is a clean transparent tasteless odourless fluid. It freezes at 0°c and boils at 100°c. Its specific gravity is taken as 1000. It has got a marked solvent action dissolving all gases and almost all solids.

Uses of Water:—(*i*) *uses in the body*—It is an essential element of diet as it enters into structural composition of all foods. It helps elimination of waste materials of the body. 28% water is excreted by the skin, 20% through the lungs, 50% through the kidneys and 2% through other secretions and faeces. As a chief ingredient of all the tissue fluids it maintains fluidity of blood and lymph. It also serves as a distributor of body heat and regulator of body temperature.

(*ii*) *Domestic uses*:—The quantity of water used for house hold purposes is 25 gallons per capita per day. The minimum amount is 17 gallons.

These are: drinking=3 pints
Cooking—5 pints.
Ablution=5 gallons.
Utensil and house washing—6 gallons.
Water closet=5 gallons.
17 gallons

(*iii*) *Municipal and Trade Purposes*:—
Trade purposes=5 gallons.

Municipal purposes like street washing, flushing of drains and sewers, fire extinguishing etc.=5 gallons.

Unavoidable waste=3 gallons.

Quantity of Water used:—Dwelling consumption depends on the class of dwelling. 1st class dewlling consume=54 gallons. 2nd class consume=34 gallons and 3rd class=15 gallons. In hospitals 40-50 gallons per head per day are to be allowed. Water allowance to animals. Horse allowance= 15 gallons, Cow=12 gallons, Mule=5 gallons, Elephant—25 gallons.

Classification of water:—This can be done as follows:-

A. According to Properties (1) clean water.
(2) Polluted water.
(3) Contaminated water.

B. According to Source:— (1) Rain water — Rivers
(2) Surface water — Streams, Tanks
(3) Ground water — wells, Springs

(*i*) *Clean water*:—This water is at all times free from contamination and safe for human consumption as determined by Sanitary Survey, Laboratory analysis and continued use.

(*ii*) *Polluted water*:—is one which has suffered impairment of physical qualities through addition of some substances causing turbidity and alteration in colour, odour and taste.

(*iii*) *Contaminated water*:—is one which carries potential infection by reason of the addition of human or animal waste or which has been rendered unwholesome by poisonus chemical compounds.

Sources of water:—(i) Rain water (ii) Surface water (iii) Ground water.

Rain water:—It is pure water occurring in Nature, but gets contaminated with dirt, gases from the atmosphere, soot, ammonia, dust and even microbes in the towns. It is very soft owing to the absence of the salts of lime and magnesia and is therefore suitable for washing, cooking and bathing purposes.

The Rain water soon reaches the ground and joins rivers, tanks etc. and is then known as surface water.

(B) *Surface water*:—These includes upland waters, Rivers, Streams, Lakes, tanks etc. *upland surface water* is derived from natural lakes in hilly districts or from artificially constructed "Impounding reservoirs" which are made to collect water from the adjoining hills by building a dam across the outlet of the valley. This exists in Salem, Coimbatore and Darjeeling. The quality of *River water* depends on the country through which it flows. Most Rivers running through the cities are polluted by discharge of effuents or otherwise. Purification of River water by natural means do take place to a certain extent which are (i) Sedimentation, (ii) oxidation (iii) action of Sunlight (iv) action of aquatic animal and plant life.

Tank water:—This if protected and kept clean forms a very good source of water and in addition the water undergoes natural purification by the process already mentioned under river water.

To make an *Ideal tank* to be used for drinking purposes. following things are to be attended to:—

(i) The soil for excavation should be a good soil with a good surrounding with no ponds, cesspools, Insanitary latrines in the neighbourhood.

(ii) should be protected with fencing and trees planted at a distance to keep away the cattle and dirt.

(iii) should be fairly deep and large. Banks to be properly sloped. The surrounding area should have a low embankment to prevent any other water getting an access into it except direct Rain water.

(iv) All bathing and washing to be strictly forbidden.

(v) Arrangements to be made for drawing water from a platform, preferably by a pump.

(vi) weeds to be cleaned regularly, tank emptied and re-excavated whenever the water deterioriates in quality.

(c) *Ground water*:—The surface water passing into the ground and lying above the first impervious layer is known as "Subsoil or Ground water."

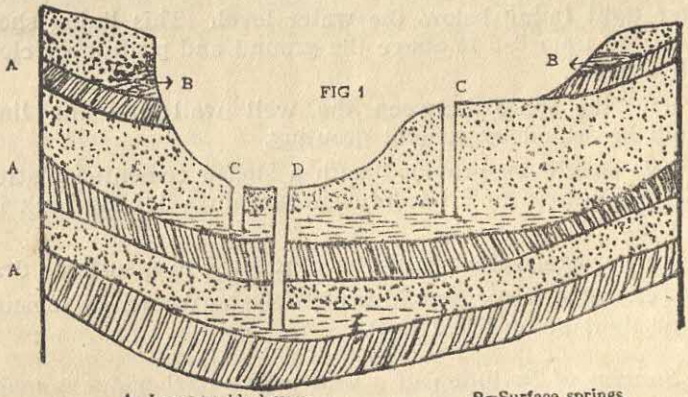


FIG 1

A=Impermeable layers. B=Surface springs.

C=Shallow well. D=Deep well

This water rises and falls according to rainfall and season of the year. This water is always moving slowly towards its natural outlet in springs wells etc. During its passage through soil rich in mineral salts and Co gas, the water becomes hard and is therefore less suited for washing and cooking.

Well:—This is an artificial hole dug into the earth to reach the underground water level.

Varieties:—(i) *Shallow wells*:—These tap the subsoil water only (ii) *Deep wells*:—These tap some water bearing layer below the first impermeable strata. (See Fig I).

Artisan wells:—These tap the water which is held between two impermeable strata under pressure. So when the upper impermeable stratum is bored the water rises in the bore hole under its own pressure to the surface level having an out-crop on the surface.

Norton's Abyssianian tube wells· These are formed by driving iron pipes ½" to 2" in diamater and 20-25ft deep to reach the subsoil water which is pumped out till clear water is obtained. This in reality is a shallow well.

Cone of Filtration:—This is the area drained by a well and is regarded as an inverted cone the apex of which is represented by the bottom of the well. The area drained is about four times the depth of the well.

An Ideal well—Requirements:—(i) It should be situated at least 30-50 yds away from any source of contamination like cesspool or Insanitary privy (ii) should be sunk below the impermeable strata. (iii) should be lined with bricks set in concrete or cement or Pre cast concrete cylindars to form a water tight lining below the water level. This lining should be carried upto 2-3 ft above the ground and preferably closed with a cover.

(iv) the space between the well wall and the lining should be sealed by cement grouting.

(v) should be provided with a sloped cemented platform covering an area of 6ft to prevent washings flowing back into the well.

(vi) waste water should be conducted to a suitable drain.

(vii) The water should preferably be drawn by means of an air tight pump fitted to it.

Sources of Pollution of a well:—The well water is mainly polluted by surface pollutions through a fissure or by direct access of surface water to deep water bearing stratum through disused wells, bore holes or by a sudden rise of subsoil water and very rarely by percolation.

Detection of the source of Pollution:—This is done by pouring of the following chemicals on to the area supposed to

be contaminating the well. (i) Strong solution of sodium chloride and detecting the increase in chloride. (ii) by alkaline solution of fluorescin (1lb of fluorescin + 1lb of Caustic soda to 10 gallons of water) and detecting the flourescin. (iii) suspension of chromobacteria prodigiosus may be added and later red colonies grown and isolated from the water.

Tube wells:—Deep Tube wells form source of good water supply. The average yield of a deep well of 1″ to 1½″ diamater is 200-300 gallons of water per hour. The yield mainly depends upon the water bearing strata and very little on diamater and depth of the tube.

Critical Velocity:—The water flows slowly through the filtering medium of sand outside the strainer of a tube well without disturbing the sand bed. But if the rate of pumping is rapid or excessive the water carries sandgrains with it and the velocity at which this disturbance starts is termed the "Critical velocity."

Cone of Influence:—With the drawing of water the level of water in the well falls resulting in a tendency of the water to flow into it from the surrounding area. The area within which the level is appreciably lowered is called the 'Circle or cone of influence."

Yield of a well:—The quantity of water in a well can be measured by water depth × Square of diameter × 5 which gives the gallons of water in the well if measured in feet. (Yield of well).

Springs:—These are natural outcroppings of ground water due to the approach of the 1st impermeable stratum to the surface by the process of natural sloping. They are either constant or intermittent depending upon the rise and fall of ground water.

Varieties of Springs:—(1) *Surface Springs*:—These are outlets of subsoil water (2) *Main Springs*:—These are deep ones having no surface outlet but comes out through a fissure or crack in the soil. (3) *Hot or Thermal Springs*:—These results from continuance of high internal temperature after a volcanic eruption has ceased:—Viz. Sitakund hot spring in Chittagong.

The Springs may also form a source of good water supply as in Kurseong. The spring water often has a medical value due to high carbonic acid gas content and its solvent action on many mineral salts which are held in solution depending upon the nature of the soil.

Dual Supply of Water:—In Calcutta dual supply of water consists of filtered and unfiltered water separately by two system of pipes mainly due to increased demand and scarcity of large amount of pure water. The unfiltered water connected to domestic places is meant only for flushing urinals, latrines and also connected to hydrants meant for street washing, flushing of sewers and fire extinguishing purposes. The filtered water is used for drinking, cooking and bathing.

Disadvantages of dual supply:—Unfiltered water supplied to dwelling houses are often misused as not infrequently they are used for personal washing for washing kitchen utensils, often for cooking and even for drinking purposes. Drinking water supplies are known to have been polluted by entrance of polluted water through cross connections leading to out break of Epidemic diseases. In Calcutta cases of Typhoid and cholera have often been ascribed to the use of this cheap unfiltered water due to the scarcity of the intermittent filtered water supply.

Distribution or supply of water:—(1) *Constant supply*:—is always preferred, for the advantage that no water has to be stored in the house as the drinking water can always be taken from the main. Plenty of water is available during emergency as in cases of outbreak of fire. There are no chance of sucking in of any gas when it is empty.

(1) *Intermittent supply*:—The water supply here is shut off everyday after running for a certain number of hours. The disadvantages are that the water has to be stored in large quantities in houses often under unsatisfactory arrangements. there is a chance of polution by leakage of sewer gas through faulty leaking joints due to suction action in the empty pipes. Delay occurs in meeting fire accidents. In Calcutta the water supply is intermittent.

Distribution pipes:—The distribution pipes in Calcutta are steelpipes ¾" thick and coated with special asphalt preparation to prevent corrosion. This is done by dipping the pipes into a bath of the mixture at a high temperature immediately after they are cast. *Angus Smith Solution* is a mixture of crudetar. Resin and Linseed oil.

In *Bower-Barff Process* the pipes are heated to a temperature of 120 F and subjected to the action of superheated steam for five to six hours. This produces a coating of black oxide of Iron.

The distributing pipes may also be made of Cast Iron asbestos cement or reinforced concrete in addition to the steel ones mentioned above.

Water Borne Diseases:—The diseases asociated with water are—

(i) *Due to Inorganic Salts*:—Diarrhoea, gastric disturbances from consumption of water containing excess of sulphates Constipation and abdominal colic from excess of zinc and lead. (1/1000 gr. of lead per gallon of water may cause plumbism).

(ii) *Due to Vegetable matter*:—Diarrhoea and gastric disturbances.

(iii) *Due to organic matter*:—Diarrhoea (Irritative) from fine particles of Sand and Mica.

(iv) *Due to specific organisms*:—Infected water give rise to the epidemics of cholera, Enteric group of fevers, dysentery etc.

(v) *Due to Parasites*:—The eggs, larvae and ova of various Intestinal parasites often enter the body through drinking water giving rise to helminthic infection like round worm, thread worm, guinea worm, bilharzia infection.

Deficiency of Iodine in water may play a part in the causation of goitre and that of fluorine during formation period leads to dental caries.

Mottling of teeth:—Excess of fluorine in drinking water causes yellow or black discolouration in the enamel of teeth giving it a mottled appearance. Essential requirement of fluorine is placed as 5 mgm per day or 1 part per million. 2 parts per million is considered to be an excess.

Impurities of water:—(1) *Dissolved Impurities*:—These are dissolved gases like excess of O_2, CO_2, H_2S etc. *Salts like* chlorides, and sulphates of calcium and magnesium *Metals* like Iron, lead and zinc, *organic matters*, Iodine etc.

(ii) *Suspended Impurities*:—(1) *Inorganic substances* like sand silt, mud etc. (2) *organic* like bacteria, vegetable and animal matters.

Sources of Impurities:—(1) *At the source* depends upon the source. Calcium causes hardness, there may also be organic matters, animal and vegetable contaminations at the source.

(2) *In transit*:—Water may be polluted by sewage, waste water, manufacturing refuse, entrance of sewer gas into the

main pipes through leaky joints specially when empty and impurities from solution of metals like lead.

(3) *In Consumers Premises*:—Contamination by filth of all sorts on account of faulty storage etc.

PURIFICATION OF WATER

(A) *Removal of Hardness*:—A hard water is due to carbonates and sulphates of calcium and magnesium held in solution. Temporary hardness is due to carbonates of calcium and magnesium whereas Permanent hardness is due to sulphates of calcium and magnesium. Hard water is unsuitable for washing and cooking.

Temporary Hardness:—It can be removed by—

(1) Boiling which drives away Co_2 gas and carbonate is precipitated out. But boiling is unpracticable in large scale.

(2) *By addition of Lime*:— Lime combines with free Co_2 and calcium carbonate is precipated.

Clark's Process:—The process of removing temporary hardness and softening it by addition of lime is known as Clark's Process. The working rule is to add one ounce of lime per 700 gallons of water for every gram of hardness. Each degree of hardness corresponds to 1 gr of calcium carbonate in one gallon of water.

Clark's Process consists of—(1) addition of necessary amount of lime (usually as 10% milk of lime) done frequently by a mechanical regulator. (2) thorough mixing. (3) sedimentation and finally (4) filtration through linen, fibre screen or squartz.

Chemical Reaction:— $CaH_2(Co_3)+Ca_0=2Ca\ Co_3+H_2O$. $MgH_2(Co_3)_3+Ca_0=MgCo_3+CaCo_3+H_2O$.

Permanent Hardness:—This may be removed by addition of caustic soda No_2Co_3 when harmless sulphate of soda is precipitated.

Chemical Reaction:— $CaSo_4+Na_2Co_3=CaCo_3+Na_2So_4$.

$MgSo_4+Na_2Co_3=MgCo_3+Na_2So_4$.

The water containing both permanent and temporary hardness as is usually the rule, can be removed by adding a mixture of lime and soda.

Base Exchange:—The softening of water can be done on a large scale by filtering the hard water through a "Permutit medium: (Permutit is Synthetic Zeolite contanung sodium or aluminium silicate) when the calcium and magnesium of hard water are replaced by sodium which passes off in the outflow.

Thus—$Na_2 Al_2 Sl_2O_8 + CaSo_4 = CaAl_2 Sl_2o_8 + Na_2So_4$. As the permutit exchange sodium base which it contains for other bases it is termed the "Base Exchange". But as the effiiciency of the permutit gradually lessens it is necessary to restore its sodium base by passing through the medium a strong solution of common salt. By mass action sodium displaces the calcium and magnesium and the life of the filter is completely renewed.

Thus:—$CaAl_2 Sl_2O_8 + 2\ NACL = Na_2Al_2\ Sl_2O_8 + CaCl_2$.

(B) *Removal of Organic Pollution*:—

Methods:—(1) Storage

	Slow sand filtration
(2) Filtration	Rapid or mechanical filtration.
(3) Sterilisation	Chlorination.
	Excess of lime method.
	Ozonisation.
	Ultra violet Rays.
	Catadyn Process.

(1) *Storage*:—This is a natural process of Purification of water and is usually resorted to as a Preliminary to some form of filtration. Storage results in dilution and sedimentation of suspended matters leading to some improvement in chemical composition of water. Sunlight by its ultra violet rays to which stored water is subjected to also helps in reduction of bacterial contamination. Finally the action of aquatic animals (fish) and plants remove the organic matter, only disadvantage is the growth of algae in the storage reservoirs leading to unpleasant taste and smell which can be successfully treated by 2-10 lbs copper sulphate per million gallons of water. Storage by sedimentation cannot get rid of helminthic ova, Protozoal cysts spores and some bacteria.

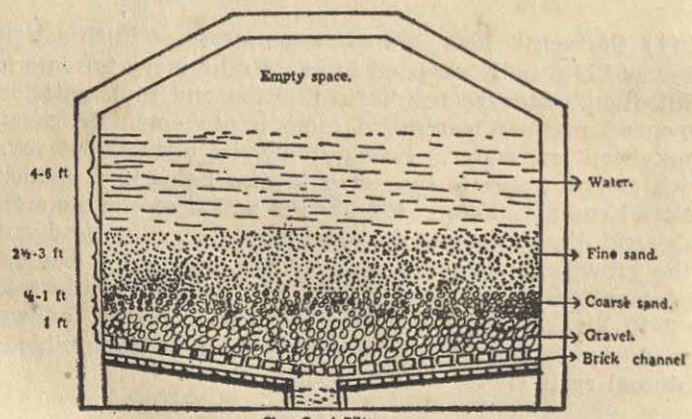
(2) *Filtration*:—The ova, cyst, spores, bacteria and suspended matters if any after sedimentation are got rid of by filtration through sand. This is the method of choice for large scale purification of water. There are two kinds of filtration—(a) Slow sand filtration (b) Rapid or mechanical filtration.

(a) *Slow Sand filtration—Working Mechanism:*—The water from the source, usually a river, away from the source of pollution and salinity is collected and stored in presettling tanks. (Kacha or Pucca). The water is allowed to circulate slowly from a higher level and then to gravitate from above downwards into the filter beds which are made of beds of sand and gravel contained in shallow reservoirs.

At the presettinf tanks sedimentation occurs by which grosser particles and suspended matters fall to the bottom. Storage of 3-4 weeks renders the water pretty safe prior to filtration. This sedimentation can be hastened by adding a coagulant such as alum which is specially done during the rainy season when the water becomes very turbid in specially constructed circular mixing troughs before entry to the presettling tanks.

The water is now made to pass through the filter beds. The filter beds are water tight rectangular masonry tanks or reservoirs, usually arranged side by side and ordinarily kept open. These are usually 9 to 12 ft deep. The top layer consists of fine sand 2½ to 3ft. (River sand). Below this is a layer of coarse sand of ½ to 1ft (Mogra sand) in depth. The complete sand layer rests on a lower stratum of gravels (Quartz Pebbles) 1 foot in depth which acts as a support for the upper sand layers. The water level is 4 to 6 ft deep and leave a margin 2-3 ft above the surface of water.

FIG 2



Slow Sand Filter.

The filtered water is collected by channels made of double layer of bricks on the floor and is lead into a filtered water well. This filtered water is sterilised by chlorination on its way to main delivery pipe by a chlorinating plant.

Mode of action:—(1) Mechanical obstruction to the impurities in the interstices of the filter. (2) Oxidation of organic matter by nitrifying organism. (3) Real biological action is carried on in the vital layer. The vital layer is a slimy deposit made up of algal growths, bacteria, colloidal silt and other organic matters deposited and formed mainly on the surface of the filter and partly in its interstices. The efficiency of the filter depends on this layer. Denser the film becomes in course of time slower becomes the rate of filtration, and greater becomes the pressure head necessary to ensure delivery of the necessary amount of water. So when the deposit gets thicker, top few inches (usually 1|2 to 2 inches) of sand has to be scraped, removed, washed and replaced, usually at intervals of 6-8 weeks. But when after repeated cleanings the fine layer of sand gets reduced to 16 to 18 inches it becomes necessary to restore and renew the bed usually every three years. The new filter takes about three days time to work (for the vital layer to form) during which time the water is either allowed to pass slowly or allowed to run to waste.

N.B. For Calcutta water Supply Palta water works has got four Kacha presettling tanks with a capacity of 80 millions gallon each and two of 20 millions gallons each. There are four filter beds with a capacity of one million gallon and eight filter beds with that of three millions gallons each.

After filtration water gravitates where it is chlorinated before discharging to the main (by Patterson's chlorinating plant). The water is pumped and collected for use in Talla Reservoir tanks placed on a 90 ft. high Pedastal. The tank is divided into four sections with a capacity of nine million gallons.

(b) *Rapid Filtration*:—*Mechanism*:—Raw water preferably turbid from the source is pumped into a collecting tank. The water is then lead into a plant to which is added a coagulant by a special gear. (Automatic regulator). The water containing these reagents now passes through a mixing trough where reaction takes place and is then lead into a sedimentation tank. The sedimentation tank is usually divdied into compartments. The coagulant hastens the deposition of suspended matters and produce an artificial surface film floc in the tank before actual filtration. The temporary hardness of water is removed, (CaCo3 forming aluminium hydrate by alum or aluminoferic which is added as a coagulant). Colouring matters gets fixed and coagulation of other impurities takes place.

Thus treated the water is next passed through mechanical filter. These are either gravity filters open at the top or pressure filters when closed. The filtering medium is con-

tained in Ferro concrete chambers usually measuring about 24 by 12 by 9 ft. The filtering medium consists of specially graded Quartz sand (3 ft.) supported on a graduated layer of Pebbles or graded gravel (1-1½ ft.). The filtered water is collected at the base of the filter by a system of strainer pipes fitted with gun metal nozzles to the number of about 2000 in each filter.

Mode of Action:—The action is coagulation, Floc formation and filtration. After flowing through the filters the purified water is collected in clean water storage tank and is sterilised on its way to pure water reservoir by automatic regulating gear. The speed of filtration is 50 gallons per sq. feet per hour. After working for sometime it becomes necessary to cleanse the filter due to deposition of intercepted impurities and loss of pressure head. This is effected by thoroughly agitating the filtering medium for about two minutes with compressed air through distributing pipes below the filter. The sand bed is broken up and the impurities loosened. Finally a reverse current of filtered water following the air agitation floats the loosened impurities to be laid into a waste channel. Such filter unit can be cleansed and restarted to work within ten minutes during which time the filtering floc is formed on the surface of the bed. (See Fig. 3).

N.B. In Calcutta very recently a Rapid filter has been installed to cope with the increased demand of Pure water supply.

Filtration Head:—The rate of filtration through slow filter is controlled in such a way so that the flow is maintained at a steady rate of four vertical inches per hour. The filtered water from the filter bed is lead into a filter well and if the water in the well is allowed to run out it is found that half inch lower level of water in the well causes a sufficient flow of water at the desired rate through the filter. This half inch difference in level is known as :Filtration head or working head.

Loss of Head:—It is the frictional resistance offered to the passage of water through the filter beds by the vital layer formed on its surface and its interstices so that after sometime half inch difference of the working head becomes insufficient to draw water at the standard rate through the sand.

Comparative study of slow and Rapid Filtration:—

Slow Sand Filter.	Rapid or Mechanical Filter.
(1) Occupies large space as a vast plot of land is required.	(1) Occupy much less space so can be housed any where.
(2) Initial cost heavy for installation.	(2) Cheaper cost of installation but running expenses are more.

Slow Sand Filter.

(3) Specially useful for water having little turbidity.

(4) Preliminary treatment is not essential though sometimes desirable. Pre-settling tank

Rapid or Mechanical Filter.

(3) Specially suitable for turbid water.

(4) Preliminary treatment is a necessity and is done first by adding coagulants. Pre-

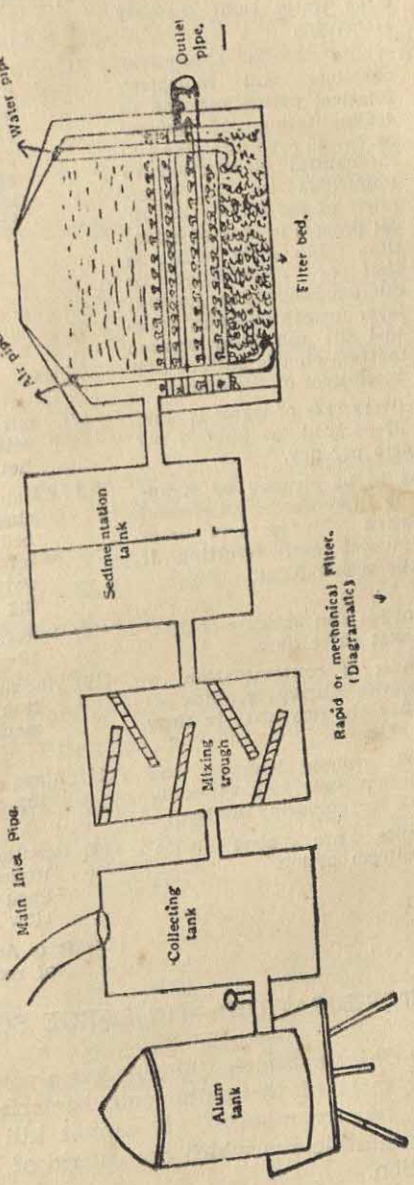


FIG 3

Slow Sand Filter.	Rapid or Mechanical Filter.
is a necessity for preliminary storage and sedimentation.	settling tank is not necessary.
(5) Water is filtered slowly through a layer of fine and coarse sand contained in large water tight masonry reservoirs.	(5) Water is passed rapidly through a Quartz Sand in small concrete or iron tanks.
(6) Working process is physical, chemical and biological. Physical action consists of sedimentation of grosser parties in settling tanks and mechanical obstruction to impurities in the interstices of the filter. Chemical process is that of oxidation. Biological action is that of nitrification by micro-organisms in the vital layer formed by algae, colloidal silt and slimy organic matters on the surface and interstices of the filter.	(6) Working process is mainly mechanical. The process is coagulation and formation of floc made artificially by producing a flocculent precipitate which with colloidal silt fill up the sand interstices in the filter.
(7) Delivery rate of water is slow. 2½—4 millions gallons per acre per day.	(7) Delivery rate rapid 100—200 millions gallons per acre per hour.
(8) Has to be cleaned by scraping superfical layers of sand when clogged and later renewal and resetting if the whole filter.	(8) Cleaned very quickly by mechanical agitation of Sand bed by compressed air and reversed by a flow of filtered water, no renewal or resetting required.
(9) Renewal and working of filter takes three days.	(9) Filter gets ready for action in 10—15 minutes.
(10) Danger of contamination by coolies during scraping as they are very dirty in their habits.	(10) No such risk of contamination as cleaning is done by mechanical means.
(11) Algal growth hampers the action and removes only 3% of colouring matter.	(11) Algae do not grow, all colouring matter are removed.
(12) Results are good with uniform action.	(12) Results are less uniform but under skilled supervision as good results are obtained as slow filter.
	(13) It is American system and is of recent use.

(c) *STERILISATION*:—(IN LARGE SCALE)

(a) *By Chlorination*:—Chlorine has a powerful bactericidal action over most of the pathogenic bacteria if it remains in contact for twenty minutes. It cannot kill spores Protozoal cyst and helminthic ova which are got rid of by filtration prior to chlorination.

Methods of Chlorination:—

(i) Bleaching powder.

(ii) Stable hypochloride solution.

(iii) Chlorine gas from cylinders or liquid chlorine.

(1) *Bleaching powder method*:—Bleaching powder is chlorinated lime or chloride of lime, the chemical name being calcium chlorohypochlorite.

Mode of action:—It unites with carbon dioxide of water and also the water itself forming calcium carbonate and hypochlorous acid—the acid breaks up into hydrochloic acid and oxygen. The nascent oxygen thus liberated also acts as a lethal agent:—

Disadvantages:—(i) extremely unstable so raidly looses its available chlorine. (From 33% to 10 or 15%).

(ii) difficult to introduce accurate dosage due to varying chlorine content.

(iii) difficult to avoid taste trouble.

All these disadvantages are now a days removed by chlorine gas in all permanent installations by a chlorinating plant.

Chlorine Content:—Fresh and good quantity of Bleaching powder should contain 33% to 32% of available chlorine but 25% is taken as a good quality.

Quantity required:—

2.5 lbs. of pure chlorine per million gallons.

8 lbs. of Bleaching powder per million gallons.

30 grs. of Bleaching powder with 25% chlorine content per 100 gallons of water, one tea spoonful of a mixture of bleaching powder (30 grs. in one pint of water) would sterilise 10 gallons of water i.e. 1|3rd gr. per gallon.

Disinfection of a well:—This is done by bleaching powder after calculating the amount of water by the formula. $D_2 \times W X_5$—gallons. Half grain of bleaching powder per gallon. Alternatively it can be done by Potassium Permanganate till faint red colour is obtained. Roughly one empty match box full of permanganate for a moderate sized well is a good working rule.

Disinfection of Small Tanks:—Done by bleaching powder after calculating the water by the formula $L \times B \times$ Depth$\times 6\frac{1}{4}$=gallons.

Disinfection of Big Tanks:—Two ounces of Bleaching powder is required for every ten running feet. Thus a tank of one bigha would measure 120 ft. on each side making 120×4 =480 running feet. So $\frac{480\times 2}{10\times 16}$= 6 lbs. Similarly to disinfect a tank of one acre calculation can be made on the same basis as one acre=3⅓ bighas.

Disinfection of a Running Stream:—Sixty six pounds of Bleaching powder is required per mile of stream water. The requisite quantity of bleaching powder is taken in a sack and is allowed to dissolve in the stream water at a higher point.

Super chlorination:—Here much larger dose of chlorine is given (2 parts of free chlorine per million gallons) with a contact for fifteen minutes in place of 1 part per million gallons with a contact for half an hour.

Dechlorination:—Excess of chlorine is removed by dechlorinating substances like anhydrous sodium thiosulphate (o.5 gm. per 100 gallons). Dechlorination removes all taste due to chlorine. The combined process of super and dechlorination destroys any unpleasant taste or odour the water may have had prior to treatment.

How to Find out the Quantity of Bleaching powder to sterilise a known volume of water?—This is done by HORROK'S TEST. The method to test is done by making at first a standard solution of sterilising powder (Bleaching powder) in a Black Cup supplied with Horrock's apparatus. The other six white cups are filled with water to be sterilised. The standard solution of bleaching powder is now added drop by drop, one drop to first cup, two drops to second cup and so on. The contents of each cup is stirred and allowed to stay for half an hour. Next indicator solution (cadmium Iodide and starch solution) is added to each cup and contents stirred again. Some of the six white cups will show no colour while others would show blue colour. The first of the cups showing blue colour is noted. Viz cup 1 and 2 shows no colour 3, 4, 5 and 6 show definite blue colour then Number 3 is to be noted. The numbers of cup showing definite colour indicate number of scoopfulls of bleaching powder required to give one part of free chlorine per 100 gallons of water at the end of contact with that water for half an hour:—Each scoop has a capacity of 2 gms. In the above case three scoopfulls of bleaching powder will be required to sterilise every 100 gallons of water.

How to know whether water has been sufficiently chlorinated for sterilisation:—This is done by *O'Toludine test*. The

water to be tested after chlorination is taken in a test tube and 2-3 drops of Otoludine is added to it. The appearance of yellow colour would indicate that sufficient chlorination has been done. Appearance of red colour would indicate excess of chlorination whereas absence of colour would indicate inadequate chlorination and more bleaching powder to be added to the water.

(2) *Excess of Lime Method*:—Free lime is bactericidal in action. After storage of water for about a week to ten days water is treated with aluminium sulphate and excess of lime amounting to one part per 50,000 is added. Water is then mixed well by agitation for half an hour and allowed to sediment for 12-24 hours. Excess of lime remaining after sterlisation is removed and finally the water is passed through the Filters. The process is cheap and reliable.

(3) *Ozonisation*:—Ozone oxidises organic matter, destroys bacteria, bleaches colouring matter, removes the taste and reduces the possibility of aftergrowth. It may be regarded as a Substitute for chlorine in the treatment of filtered water. It is conveniently used for purification of swimming bath waters which is done by a plant (ozoniser) in which ozone is produced from air by means of high tension current and a steriliser in which water and ozone are admitted near the base.

(4) *Ultraviolet* Rays:—are germicidal but seldom used to purify water on a large scale.

(5) *Catadyn Process*:—Catadyn is the name given to an activated form of silver which is made to deposit on particles of sand. "In this process minute quantities of silver go into solution in the form of silver ions which attract oxygen from air dissolved in water and the bacteria are killed". (Oligodynamic action).

The water is passed through a filter containing this catadyn sand and is sterlised within 2-12 hrs. Different types of instrument are available. A recent modified method is available in which silver is deposited on electrodes through which an electric current is passed. Another is a bead type steriliser in which catadyn covered beads threaded on silver wire can be kept immersed in any vessel.

PURIFICATION OF WATER IN SMALL SCALE

(1) *Boiling*:—Useful and practicable only for domestic use.

(2) *Distillation*:—Only useful for chemical and medicinal use.

(3) CHEMICAL TREATMENT

(i) *Bleaching powder*:—The water after rough filtration is treated with stock solution of bleaching powder by half to one teaspoonful of fresh powder to a pint of water. This will sterilise 10 gallons of water in half an hours time.

(ii) *Alum*: *Alumino Feric*:—Alum is not a true germicide and is chiefly used as a coagulant in rapid filters. Aluminoferric is alum plus 1% Feric Sulphate which when added to water drags down the particles of suspended matter and bacteria.

2½ grs. of alum or aluminoferric added to one gallon would rapidly clarify all water. An addition of alkali (Lime ½ gr. to per each grain of alum) greatly helps the process.

(iii) *Potassium Permanganate*:—It is a germicide and can be usefully employed in sterilising water of wells, cisterns. It is largely and commonly used in dealing with suspicious wells during cholera outbreaks. 3p per 100 gallons would ordinarily disinfect the water. 5 parts per million removes 95% of bacteria in 6-8 hrs.

(iv) *Nesfields' tablets*:—Two grains tablet of Iodo Iodate of Soda and citric acid added to four gallons of water is said to kill pathogenic germ like cholera and typhoid. It acts by liberating certain quantity of nascent Iodine.

(v) *Chloramine*; *Cuprichloramine*:—Powerful germicidal agents, chloramine is prepared by interaction of chlorine and ammonia while the latter is a combination of chlorine copper and ammonia. Ammonia helps by preventing rapid dissociation of chlorine and thus prolonging its action.

(vi) *Chloresone*:—This is a specially prepared mixture of Bleaching powder and quick line containing 30% of available chlorine.

(vii) *Copper Sulphate*:—Prevents algal growth and accumulation of slime on both sides and bottom of the reservoirs. (7 gr. per gallons and 2-4 lbs per million gallons).

(4) *DOMESTIC FILTERS*:—(i) *Four Ghurra method*:—water preferably after straining is put in earthenware vessels placed on top of one another in a wooden frame. It is made to pass through powdered charcoal fine sand and gravel and finally received in the lowest vessel (4th). The method is unreliable and not at all protective against the organisms.

(*ii*) *Pasteur Chamberland filter*:—Water is made to pass through unglazed porcelain tubes—termed the filter candles contained in a case which separates fine particles of suspended matters and bacteria by filtration. It is a reliable filter and is commonly used in dispensaries and Laboratories.

(*iii*) *Berkefield Filter*:—It is of the same type but is made of di-atomaceous earth better known as "Keieselguhr". It is less reliable than Chamberland. "Meta filter", 'Stella filter" are recent improvements on those filters. Here filtration is made through a bed of specially manufactured Keieselguhr supported in a metal case. These were extensively used in military field units.

How to take sample of water for bacteriological examination:—A four ounce of glass stoppered sterilised bottle is used for collection of water from the source of supply. From a tap after allowing the water to run for five minutes. From a well by tying a lead weight to the bottle and suspending it by a sterilised piece of string. From a tank, sample to be taken a little distance away from the bank.

The stopper is taken out with sterilised forceps after flaming the neck for half a minute and is replaced in the bottle exactly in the same way after filling the bottle with the sample of water in such a way that no air bubble is retained. The sample is forwarded with certain informations regarding the water and its source.

Bacteriological Standard:—Absence of B.Coli Non lactose fermentors) in 100 c.c. of water is ideal. Presence of two coli per 100 c.c. of water is good. Presence of two to ten coliform organism is intermediate, presence of ten or more per 100 c.c. is bad.

N.B.: *Mills Reincke Phenomenon*:—In 1893 H. F. Mills in America and J. J. Reincke in Germany observed that following filtration of water there was a marked decrease in general death rate among the population not only from typhoid fever but from other diseases as well.

This observation is known as M. R. phenomenon.

CHAPTER THREE

AIR AND VENTILATION

Composition of Air:

	Inspired air	Expired air
Nitrogen ..	.. 78 7 %	79.19%
Oxygen ..	.. 20.95%	16.4 %
Carbon dioxide	.. 03,04%	3.4 %

It also contains trace of Hydrogen Ammonia. Nyon, Cyston water vapour, dust and radio-active substances.

N.B.—The expired air contains 4-5% less oxygen and 4% more carbon dioxide.

EFFECTS OF ILL VENTILIATION:—The ill effects in a closed ill ventilated room are mostly due to physical factors and not due to any lack of oxygen or excess of carbon dioxide as once believed. This has been proved experimentally by Sir Leonard Hill. Similarly presence of some organic poison in the expired air causing those ill effects have also been discarded.

The discomforts of a confined atmosphere are due to excess of moisture (humidity over 76%) and lack of air movement causing heat stagnation, i.e., prevention of heat loss by radiation and evaporation from the surface of the skin. The other environmental factors on which heat loss depends are temperature, humidity, velocity of air and temperature of surrounding air. The temperature moisture and windless stagnant atmosphere in these places primarily diminish heat loss and secondarily the activity of the occupant. For want of adequate heat loss from the body extra strain is put on the heat regulating mechanism. Skin vessels dilate, more blood goes to skin, where it circulates in greater volume so that less blood goes to viscera and brain. With the dilatation of cutaneous vessels, surface temperature rises due to increased blood flow, veins get filled, blood pressure falls and heart becomes fatigued. In fact the whole metabolism is thrown at a lower plane, the nervous system and the muscular tone remain unstimulated by monotonous motionless air. At the same time overcrowding which is always associated with ill ventilation increase the risk of droplet infection. Number of pathogenic organisms are increased from perspiration, foul breath arising out of of Pyorrhoea etc. increases the incidence of diseases.

In certain number of cases the effects of illventilation and overcrowding may lead to acute symptoms like nausea, vomiting, loss of muscular power, faintness, giddiness, unconsciousness and even death from medullary paralysis.

N.B.: Lack of oxygen in inspired air fail to produce any effect as consciousness is not lost until oxygen percentage sinks below 10% which rarely, if ever happens at all. This reduction of oxygen percentage is impossible in any illventilated overcrowded room. Similarly no effect is produced unless carbon dioxide concentration of the atmosphere is increased to 3% or more. It is seldom so even in packed Theatre and Cinema halls.

Vitiation of Atmosphere:—The atmosphere is vitiated from three sources.

(1) *Impurities of Respiration*:—Micro-organisms are given off in forced expiration and body excretions. During loud talking, organisms may be sprayed up to 4 ft. and by coughing to a distance of 10 ft. organisms given off from infected persons retain their vitality for varying periods of time in dust and may continue to propagate diseases by inhalation.

(i) *Impurities of Combustion*:—The products of combustion from factory furnaces, burning of coal for domestic use give rise to Co, Co_2 and sulphur compounds.

(ii) *Impurities of Trades*:—These include dust and injurious gases. Dusty trades produce silicosis from silica and stone dust, siederosis from iron dust, Byssinosis from cotton dust and anthracosis from coal dust. All these produce certain changes in the lungs by inhalation termed Pneumokoniosis.

The poisonous gas and vapours are carbon monoxide, ammoniacal vapours, hydrochloric acid vapours, sulphureted hydrogen, carbon bisulphide, etc.

Smoke Nuisance:—Smoke is produced by imperfect combustion of coaltar vapours. During combustion sulphur dioxide compounds are also produced which pollute the air. Smoke injures health and affects comforts both directly and indirectly. It increases the fog, shuts out the light, reduces the amount of ultra violet rays, soils with soot and deters the opening of windows to let fresh air. It is irritating to the eyes, skin and mucus membrane due to its tar content. It damages buildings, vegetation and acts as a contributory factor to the development of respiratory diseases.

The nuisance of domestic smoke can be overcome by substi tution of gas fires or electric cooking. Factory smoke can be reduced by numerous mechanical devices.

Industrial Impurities and their Effects:—The industrial impurities are.

(i) *Gases*:—Carbon monoxide and Dioxide, Hydrochloric acid vapours, Ammonia vapours, Hydrogen Sulphide, Carbon bisulphide; Nitrous fumes etc.

(ii) *Inorganic*:—Arsenic, lead, zinc, phosphorous. Mercury Etc.

(iii) *Organic*:—gelatin, glue.

(iv) *Dusty trades*:—These are coal dust Iron dust, stone dust, silica, asbestos, jute and cotton dusts from those industries.

(1) *Gases*:—(a) *Carbon monoxide* (Co.)—*source*—Domestic—From stove, ovens (Coal, Coke) Sigri etc. Motor Exhaust Running Engine in a closed garage. Industrial Sources are from coal, watergas production, Blast furnace mine explosion, copper smelting etc.

Toxic percentage:—.08% cause half saturation of haemoglobin .1% produce symptoms in one hour .3% unconsciousness and .4% death. Carbon monoxide fixes the haemoglobin by forming carboxyhaemoglobin, (260 times affinity for H.B.).

(ii) *Carbon dioxide* (Co_2)—*Source*:—Brewery vat fermentation wine manufacture, lime kiln, brick field and cement works.

Toxic Percentage:—3% cause dysphoea, 6% marked distress, 10% unconsciousness and death. 20% saturation in blood cause symptoms and 50 to 60% cause death.

(iii) *Carbon Bisulphide* (CS_2)— *Source*:—Rubber vulcanising industry, artificial silk and leather industries. It is a highly poisonous and inflammable gas.

(iv) *Sulphuretted Hydrogen*:— (H_2s) —*Source*—old blocked wells; chemical industries like tanning decomposition of organic materials etc., storage of green hides: breweries and sugar factories; in sewers and excavations.

Toxic percentage—0.1 to 0.3% rapidly proves fatal.

(v) *Hydrochloric acid gas and ammonia vapours*:—*Source*—From alkali manufacture. These are very irritating to mucus membrane and respiratory tract.

(vi) *Nitrous Fumes*:—*Source*—manufacture of nitric and sulphuric acid, manufacture of explosives, of celluloid and cordite. It is dangerous and cause oedema of the lungs after only a short exposure.

(vii) *Coal gas*:—produced by destructive distillation of coal tar and finally purified by the removal of sulphur compounds contained in it. Its average composition is as follows:—

H_2=46% Co=7%. CH_4=37%. Illuminants 5% like ethelyne, acetylene Benzol etc. sulphurous acids etc. 5%.

It is used for burning purposes.

(viii) *Blue water gas (Producer gas)*:—is produced by passing steam through incandescent coke and is mainly composed of carbon monoxide and hydrogen. It is dangerous due to high Co content which may be as high as 50%.

(2) *Inorganic Substances*:—(1) *Arsenic*—derived from alloy metal works; Paris green and wall paper manufacture galvanising and preparation of certain dyes.

(ii) *Lead*:—derived from plumbing, welding, soldering etc.

(iii) Mercury:—manufacture of Thermo meters, Baro meters and vermillion industry.

(iv) *Phosphorous*--From match factory.

(v) *Zinc*:—From Brass works.

The injurious effects of all these are too well-known.

(3) *Organic Substances*:—Gelatin and glue are derived from hide and hoof industries.

What are the offensive trades? (1) Blood boiling or blood drying, (ii) Bone boiling, (iii) Gut scraping, (v) Fat and tallow melting (in making soap) (vi) fell mongering (in tanning of skin) (vii) Paper making, (viii) Dusty trades (see before). (ix) oil and Rice mills. (x) keeping of and slaughter of animals.

Diseases Due to Dust:—(1) Lead, arsenic, manganese, etc., which act as systemic poisons. (2) Lime, arsenic, chromic acid and bichromates which act as irritant and corrosive dusts.

(3) Foreign proteins in the dust cause allergy.

(4) Dusts of pitch, radio active materials and certain ores act as carcinogenic agents.

(5) Dusts carrying infections produce, anthrax, actinomyces, tuberculosis, moniliasis.

(6) Nontoxic inorganic dusts produce change termed Pneumo koniosis. These vary depending on the nature of the dust inhaled. These are anthracosis, silicosis, lithosis, siderosis, byssinosis.

Requirements of a Good Slaughter House:—(1) It should be placed 30 to 50 yards away from a dwelling house, (2) should have proper ventilation and as much open as possible on two sides, (3) should have a good arrangement of water and means of disposal of sewage by proper slope, impermeable floor, drain, gulley traps, etc., the last named one being necessary to prevent the offensive gases entering the slaughter house, (4) should have no direct communication between water

closet or privy and the slaughter house, (5) should have no room on its roof for residential purpose, (6) should be provided with self closing doors, and windows with fly proof arrangement, (7) skins, offal, etc., should be removed within 24 hours —storage in non-absorbent receptacles which is to be kept clean when not in use.

N.B.—*Abattoir*:—It is a name for a public slaughter house (French).

VENTILATION.

Def:—Ventilation is the 'science of maintaining atmospheric conditions which are comfortable and healthful to human body."

Ventilation means bringing in of good air from outside in order to dilute and remove the products of respiration as well as other sources of vitiation. It also means maintaining the air of the room at a proper temperature and humidity and to keep the air of the room in a gentle continuous motion. Last but not the least it means purification, of air by removal of gases, odours, bacteria dust, etc., contaminating the air of the room.

SYSTEM OF VENTILATION.

(A) *Naural Ventilation*:—

(1) Diffusion.

(2) Perflation.

(3) Aspiration.

(4) Difference of temperature.

(B) *Artificial Ventilation*:—

(1) Vacuum system.

(2) Propulsion system.

(3) Balanced system.

(A) *Natural Ventilation*:—This is the ventilation that occurs naturally inside the dwelling houses also sometimes known as Internal Ventilation.

(1) *Diffusion*:—The rate of diffusion of gases varies inversely as the square root of their density (Graham's Law) The houses are usually constructed by some porous material so that slight amount of interchange of inside and outside air always takes place by this process.

(2) *Perflation*:—This means blowing of air through doors and windows by natural movement of air and therefore

depends entirely on the action of the wind which acts by above manner.

(3) *Aspiration*:—This is effected by sucking action of air from a space across which wind blows, e.g., wind blowing over top of a chimney exerts a suction action on the air in the flue.

(4) *Difference of Temperature*:—There always occurs a movement between masses of air of unequal temperature. Hot air being lighter soon rises and is replaced by a current of cold heavy air. The greater the difference of temperature greater will be the velocity of the incoming air.

(B) *Artificial Ventilation*:—Here the air is set in motion by some mechanical means. The different methods are: —

(1) *Vacuum System or Extraction Method*:—This is done by heat, exhaust fans, fire with flue, etc.

(2) *Propulsion or Planum System*:—In this system air is forced or propelled into a room which pushes out the vitiated air. The volume of air can be regulated by fitters, wet screens. Propulsion is usually done by the revolving fans.

(3) *Balanced System*:—This is the combined method of propulsion and extraction. This is the best method. Air is propelled through openings near the ceiling and extraction through openings in the floor usually placed under the seats. This is commonly employed in cinema and theatre halls.

Exhaust Ventilation:—It is actually an extraction method of artificial ventilation particularly employed in factories to prevent inhalation of dusts, e.g., coal, silica, iron and cotton dusts and poisonous fumes like arsenic, phosphorous, nitro and amino derivatives of benzene, etc. The exhaust ventilation is applied as near as possible to the point of origin of dust and fumes and so arranged as to prevent the dust from entering the atmosphere of the workroom.

As already mentioned the exhaust ventilation works on the extraction system. The air of the room is extracted through outlets and dust free air is made to enter through inlets to replace the extracted air. The exhaustion is carried on by system of exhaust fans and ducts which convey the dust and the fumes to some other point of the factory for final disposal.

External Ventilation:—This consists of provision of open spaces, Parks, etc. to allow free circulation of air around the individual dwellings. Ten feet back space and four feet side space around each residential house is a legal requisite.

Inlets and Outlets:—These are openings for carrying out ventilation. Inlets admit fresh air. Doors and windows are thus nothing but natural inlets. Special inlets are placed five feet above the door or higher with some arrangement for deflecting the air upwards as it enters the room (24—28 square inch in area for each person). The outlets are placed near ceiling through which foul air in the room escapes, making room for the fresh air to enter through the inlet.

Amount of Fresh Air Required:—The amount of fresh air to be delivered can be calculated by the following formula.

(Deshmund)—

D—Delivery of fresh air.

E—Exhaled amount of Co_2 per hour in cft.

P—Permissible impurity in terms of cft. of Co_2.

Delivery of Fresh Air:—Actual amount of Co_2 exhaled per hour in cft. divided by permissible impurity in terms of cft. of Co_2 2 cft. per 100 cft. is taken as the permissible respiratory impurity as when the air of a room exceeds by more than 2% of Co_2 stuffiness becomes apparent to the senses.

Thus $D \frac{.6 \text{ cft. (amount of } Co_2 \text{ exhaled per head per hr.)}}{.002 \text{ (.02 per 100 cft. or .002 per cft.)}}$

=3000 cft. of air. Thus an individual should on an average receive 3000 cft. of fresh air per hour for maintaining satisfactory ventilation.

Air and Amount of Cubic Space:—The ideal standard for dwelling room is 1000 cft. (10×10×10). Length by breadth by height per individual. This allows air to be renewed three times in course of an hour. But it must be remembered that floor space is more important than height as air tends to stagnate in upper zones of a very high room so in calculating cubic space any height over 12 ft. is neglected.

Cool Air:—Hot air is passed through some cooling device and is made cool. Cool air is usually saturated with water vapour. It is not purified air.

Conditioned Air:—It is a regulated air, which is cleaned, and warmed or cooled as per requirement. The conditioned air is purified and contains very little or no water vapour.

SPECIAL VENTILATION OPENINGS

(A) *Window Openings*:—

(1) *Double Sash Windows*:—Sashes work up and down on pulleys in a frame.

(2) *Casement Window*:—Sashes are hinged on the side of a frame.

(B) *Wall Openings*:—

(1) *Ellisons Brick*:—Brick with conical holes.

(2) *Sherring Ham's Valve*:—These are flapwindow near ceiling, the wedge of which projects inside the room and guide the air upwards

(3) *Tobin's Tube*:—5 to 6 ft. high placed vertically in the wall from the floor. Its lower end opens into the outside air.

(C) *Roof Openings*:—

(1) *Cowls* as seen in roofs of railways and tram cars—the foul air is aspirated when it is in motion.

(2) *Macknell's*:—It is a combined inlet and outlet made in the form of a double tube, the outer one acts as an inlet and inner tube as an outlet.

Examination of a Room for efficient Ventilation:—The following points are to be particularly noted:—

(1) Sense of impression for stuffiness on entering the room.

(2) Measurement of floor space, height of the room in relation to the number of-occupants.

(3) Arrangement of ventilation—open windows, Inlets etc.

(4) Lighting arrangements.

(5) Temperature of outer and inside air by kata thermometer readings if possible.

Kata Thermometer:—This instrument is a large bulb spirit thermometer graduated from 95 to 100 deg. F for measuring the rate of cooling or heat less.

Types:—(1) *Dry Kata*:—In this the bulb is uncovered and records the cooling power of the air obtained by radiation and convection.

(2) *Wet Kata*:—In this the bulb is covered with a wet silk or fine cotton meshing. It records the cooling power of the air obtained by radiation, convection and evaporation.

Readings:—In a hot stuffy room dry Kata reading will be low on account of poor radiation and convection. An Indoor reading of 6 indicates invigorating atmosphere. Below 6 room becomes progressively stuffy and above 6 cooler and fresher. The wet Kata reading of 18 indicats invigorating atmosphere. Difference between dry and wet Kata reading of 12

indicates comfortable atmosphere, less than 12 hot and stuffy; more than 12 too cool for sedentary work.

Cooling powers—The rate of heat loss per square c.m. of the bulb in the Kata per second is known as cooling power and is expressed in micro calories.

Air Borne Diseases:—Infection spreads through air either by inhalation of dust or by droplet. Diseases produced are silicosis, siderosis, anthracosis etc. Tuberculosis and Pulmonary form of anthrax. Small Pox, Chicken Pox Mumps, Measles. Diphtheria and Scarlet Fever, allergic conditions and some virus diseases. But how much role exactly is played by the air is still not known.

Anemometer:—An instrument for recording the velocity of air i.e. distance travelled within a fixed hour the velocity per ft. per second is recorded.

Eupathoscope:—An instrument for measuring equivalent temperature. It provides an index of the combined effects of temperature, movement and radiation of air.

Vital Capacity:—It is also known as respiratory capacity or extreme differential capacity and denotes the maximum volume of air that can be expired after a maximum inspiration. The usual range is 3000 to 5000 c.c. but the amount varies according to age, height, weight and vigour of an individual.

CHAPTER FOUR

SOIL AND HOUSING—

Alluvial or Drift Soil:—This is formed by the deposition of materials elsewhere after being carried away by currents of water. The soil is usually found in valleys along which river flows, and the deltas in the mouths of big rivers.

Filled or Made Soil:—This results from filling up of tanks, hollows and other excavations of the ground by refuse or other rubbish.

Precautions for made Soil:—(7) The sites should be made dry if not already dry by drawing out the water.

(2) Filling to be started in such a way so as to complete the work before the advent of rains.

(3) Refuse material to be deposited in layers not exceeding 6 ft. in depth and covered with 9 inches of earth so that no surface remains exposed to air.

(4) Filling to be done to the extent of 2 ft. above the surrounding level to make room for settlement.

(5) Fresh layer of refuse and earth should not be deposited before the setting down of the previous layers.

(6) The site thus filled should not be used for any construction purpose before ten years.

Damp-Proof Course:—This is a layer of impermeable material which prevents the passage of dampness from below into the building. The course usually is laid horizontally along entire thickness of each wall just above the point where the wall leaves the earth, but below the level of the floor to impose an effective barrier to the upward progress of moisture. The materials used for this purpose are—(1) Lead sheet (2) Two layers of slates (3) Well tarred or vitrified bricks (4) Patent stone one inch thick made with cement and stone chips (4) Asphalt-2" thick.

Nitrogen Cycle:—This is a complex process of bacterial action that takes place in the superficial layers of the soil by the soil bacteria and the plants. This process is very helpful in prevention of soil pollution and disposal of sewage. It consists of two process—

(1) Catabolism:—breaking down of organic animal matters.

(2) Anabolism:—making up from broken down products.

The animal proteins are broken down through the stages of Proteoses, Peptones, amino acid to ammonia. The ammonia is oxidised by the nitrifying organisms into nitrite and finally nitrates. These are absorbed by the roots of plants which convert some of them into vegetable proteins, others are absorbed and held in solution by ground water.

Burial Ground:—A ground to be suitable for burial purpose should have subsoil water varying from 6 to 300 ft. The burial hole to be dug 3 ft below the ground surface and 2 ft above the subsoil water. The space between each grave dug should not be less than 4 ft.

Construction of Cow sheds:—Cow sheds should be constructed as a separate structure in a dry ground and preferably at a distance of 20 ft. from the nearest dwelling house and 50 ft. away from the source of water supply. Floor of the cow shed should be made of impervious material like cement concrete, stones or Fire bricks with proper slope and drainage leading to a receptacle or the sewer. Accomodation space required for each cow is 800 cft. (10×8 ft.). Each cowshed should have a feeding passage (4 ft. wide) at head end and a milking and dunging passage (4½ ft. wide) at their tail end. Arrangement for drinking in cement tanks or basins. Lighting and ventilation should be good. The cow shed should be washed before milking.

Dwelling House:—An ideal dwelling room should provide 1000 cft. (10×10×10)—with a provision of 10 ft. back space and 4 ft side space. Height should be double the size of the street so that a road angle of 45. is maintained

Inspection of a House:—A house to be declared fit and healthy should satisfy the following conditions:—

(1) Free from dampness and be in a dry condition.

(2) Properly lighted and well ventilated.

(3) Properly drained with a arrangement of disposing waste water.

(4) Fixed bathing arrangements preferably in a separate place with proper accomodation for domestic washing.

(5) Adequate supply of pure water for drinking and cooking with facilities for storage.

(6) Facilities for preparing and cooking food with a provision for a well ventilated store room.

(7) Arrangement for accumulation of house refuse and their removal.

(8) Latrines preferably sanitary or at least a septic tank one.

(9) Should be in a good state of repair.

(10) Domestic animals should be kept under proper hygienic conditions.

Diseases from the soil:—(1) Helminthic infections from vegetables grown on polluted soil—particularly hook-worm infection. (2) cholera, dysentery, Typhoid indirectly by flies. from polluted soil. (3) Tetanus, Gasgangrene, anthrax from infected soil.

CHAPTER FIVE

FOOD AND NUTRITION

Nutrition is a complicated combination of many processes by which the structural and functional efficiency of every cell is maintained and nourishment of the body is effected.

Proximate Principles of food:—The following proximate principles of food are required to maintain nutrition of the body.

Proteins are essential to the body for its growth, repair, nutrition, vitality and general well-being. Without protein life cannot exist.

Proteins are necessary in children for their body growth and in adults for replacement of loss due to continuous wear and tear of the body as it works incessantly day and night. The cell structure is mainly composed of proteins. Tissue synthesis and body development cannot occur without protein. The enzymes, hormones, antibodies, plasma proteins, body pigments, haemoglobin and many other vital substances are manufactured chiefly from proteins by the body. Proteins are also concerned with maintenance of osmotic equilibrium. This shows how essential they are and what useful role they play in working of life process.

Proteins are very complex substances. They are not diffusible and therefore cannot be absorbed as such. Proteins as a consequence are required to be broken into their primary components i.e., aminoacids. And it is in this form that proteins are absorbed from the digestive tract and stored in the liver. From liver they are released according to the demand of the body. To put it in a nut-shell, aminoacids are chemical building blocks to build the body and function to nourish, build, repair and regenerate cells and tissues.

Proteins are classified into 4 broad groups according to their availability:

1. *Vegetable Proteins:* They are inferior to animal proteins for lack of one or the other essential aminoacids. Addition of a small quantity of meat protein, liver or milk greatly enhances their biological value.
2. *Meat Proteins:* These are better than vegetable proteins in nutritional value and are more akin to human proteins than vegetable proteins.

3. *Liver Proteins*: They are much superior to vegetable and meat proteins. They supply as many as 11 aminoacids viz. Arginine, Cystine Histidine, Isoleucine, Leucine, Lysine, Methionine, Threonine, Tryptophane and Valine.

4. *Milk Proteins*: These are excellent from nutritional point of view and provide 18 aminoacids, the following in addition to liver proteins viz., Alanine, Aspartic acid, Glutamic acid, Glycine, Proline, Serine, Tryosine. Milk is thus the most ideal and richest source of essential aminoacids in comparison with the above 3 groups.

Clinical indications for protein therapy are: gastrointestinal disorder, prolonged fever and wasting diseases, pre and post-operative conditions, wound healing, and bed sores, burns, pregnancy and lactation, hypoproteinaemia, antibody-formation, hepatic diseases and liver toxins, convalescence, haemorrhage, anaemias and infections.

The proteins are again broadly divided into two groups according to their source.

(1) *Animal Protein*:—From milk, meat, fish, eggs and biologically more adequate hence known as *Superior proteins*, The biological value represents the percentage of digested proteins utilised to replace tissue waste.

(2) *Vegetable proteins*:—From cereals, pulses, nuts and are of lower biological value hence known as *Inferior proteins*.

Some of the amino acids are associated with specific bodily functions such as phenylalanine or tryptophane with adrenaline and thyroxine formation, methionine with protection of Liver against toxic effect of various substances.

The *essential amino acids* are glycine, alanine arginine; Tyrosine; Leucine; phenylalanine; valine; methionine, Histidine and Isoleucine.

(B) *Carbohydrate*:—These are starchy food which are cheap, readily obtained and supply 40% of energy requirement of the body.

(C) *Fat*:—These are esters of glycerol and fatty acids. Fatty food mostly Contain lecithin and phosphoric acid which help to build the nervous system.

(D) *Vitamins*:—These are complex organic substances essentially required to carry out specific bodily functions viz., tissue oxidation, metabolism, production of hormones, nutrition of body cells and growth and to maintain normal bodily health. They do not supply energy.

Classification of Vitamins:—They are classified as follows

(1) Fat Soluble:—(ADEK)
- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K

(2) Water Soluble.
- Vitamin B Complex Group.
- Vitamin C

FAT SOLUBLE VITAMINS

(a) *Vitamin A*:—*Derivation*:—Derived from plant pigment carotene formed in the animal body from B Carotene only.

Sources:—(1) Chlorophyll of green vegetables, milk, cheese cream, butter, yolk of eggs, shark, halibut liver oils.

Resistance:—Thermostable. Cooking does not destroy it.

Unit:—Specific activity contained in .06 microgram of the standard preparation of B carotene.

Daily requirement:—4000 to 6000 I.U. in children and 2000 to 4000 I.U. in adults.

Function:—Anti infective.

Deficiency:—Produces nyctalopia, xerophthalmia, Keratomalacia, Phrynodermia of sebaccous follicles of the skin. Predisposes to infection of respiratory and Intestinal tract.

(b) *Vitamin D*:—*Derivation*:—Synthetically prepared from Ergosterol (an inactive constituent of yeast and ergot of Rye) by irradiation by ultra violet rays. Naturally it is produced from skin by action of the sun's rays.

Sources:—Cod and fish oils, fat of animals, butter milk, yolk of egg. (absent in green vegetables).

Resistance:—Heat stable.

Unit:—Corresponds to 1 mgm. of standard solution of irradiated ergostrol. (.025 microgram of calciferol).

Requirement:—500 to 1000 I.U. in children. 400 to 600 I.U. in adults.

Function:—Promotes absorption of calcium and phosphorous and directly concerned with calcification of bones.

Deficiency:—Leads to Rickets in children and osteomalacia in adults, defective dentine and enamel formation in teeth.

(c) *Vitamin E*:—*Derivation*:—Tocopherol from wheat germ oil.

Source:—Embryo of wheat, commercial oils like wheat germ oil, cotton seed, palm and Rice germ oil. Seeds and green leaves of cereals, lettuce, peas etc.

Unit:—amount equivalent in specific activity to one microgram of synthetic tocopherol.

Requirement:—not definitely known.

Function:—Antisterility.

Deficiency:—Leads to death of the products of conception; sterility in females, oligospermia in males and muscular dystrophy.

(o) *Vitamin K*:—*Derivation*:—a napthoquinone derivative.

Source:—Spinach Tomatoes, Cauliflower, Cabbage, Chestnut, Soyabeans, Liveroils (Hog.)

Unit:—1 grm. of vitamin K is equivalent to 12 million chick curative unit otherwise called a "Dam Unit".

Function:—maintains normal level of plasma prothrombin and consequently normal coagulability of blood.

Deficiency:—leads to marked prolongation of coagulation time and clotting time, tendency to haemorrhage from any cause.

Water Soluble Vitamins:—

Vitamin B Complex—

(1) *Aneurine*:—*Thiamine*:—((Vitamin B1):—

Derivation:—Synthetically obtained from thiamine hydrochloride.

Source:—Rice polishings; yeast; wheat; cereal; Pulses; Mutton; Pork, Fish, milk, green vegetables and some green fruits.

Unit:—equivalent to three mcgm of Aneurine hydrochloride.

Function:—Antineuritic. The vitamin is essential for the nutrition of nerve cell and an essential factor in transmission of nerve impulses augmenting the activity of acetyl chline at the nerve endings. It also plays a part in water exchange of body fluids and cellular metabolism.

Deficiency:—Causes Neuritis; Beri-Beri; Intestinal atony; anorexia; dyspepsia; chronic constipation; mental depression, lassitude and irritability.

Requirement:—Daily requirement is one mgm. which corresponds to 333 I.U.

(2) *Riboflavine* (Vitamin B2):—

Source:—yeast; green vegetable; milk; liver, egg; fish, sprouting peas.

Unit:—No international standard. Pure substance available.

Function:—helps tissue respiration and carbohydrate metabolism. It is essential to mechanism of vision and cellular growth and nutrition.

Deficiency:—general:—cheilosis—angular stomatitis with transverse fissures; soreness of lips and gums; scaly disquamation of nasolabial fold and characteristic glossitis.

Ocular:—Vascularisation of Cornea (Characteristic) Lachrymation, photophobia, blepharospasm and loss of visual acuity.

Recently clinical investigation has shown a significant relationship between low Riboflavine excretion and such complication of pregnancy as vomiting, pre-maturity and deficient lactation.

Thus it may play an important part during pregnancy.

Requirement:—1.5 to 3 mgms.

(3) *Pyridoxine* (Vitamin B6):—(Adermine).

Source:—Yolk of Egg; Soya bean; yeast; Liver Milk. Very little in vegetables.

Unit:—No international standard. Pure substance available.

Function:—plays an essential part in protein metabolism—"transamination reaction"; in the control of R.B.C. formation and muscle metabolism. It may also be a factor in maturation and emigration of polymorpho-nuclear leucocytes.

Deficiency:—leads to hypochromic anaemia; neuromuscular disturbances; nervousness; Insomnia; irritability, weakness and difficulty in walking and convulsive epileptiform seizures. Skin lesions round eyes, nose and mouth like that in Riboflavine deficiency. Anteriosclerotic lesions have also been reported.

Requirement:—Human requirement not yet determined.

(4) *Nicotinic Acid* (Vitamin B7):—(Nicotinamide).

Source:—Liver; Yeast; Meat; Cheese; Cereals. Egg in association with other members of Vitamin B Complex.

Unit:—No international standard. Pure substance available.

Function:—It is pellagra preventing factor essential for normal functioning of gastro-intestinal tract, skin and nervous system, helps haematopoeisis).

Deficiency:—gives rise to Pellagra—"Diarrhoea, Dermatitis Dementia." Acute deficiency leads to encephalo-pathic syndrome characterised by mental confusion, clouding of consciousness, cog wheel rigidity, stupor and delirium.

Requirement:—Daily requirement is 12 to 18 gms.

(5) *Pantothenic Acid*: (Panthenol).

Source:—Liver; kidney; yeast, wheat bran, molascess. It is also produced by moulds, micro-organisms and green plants but usually bound to protein.

Unit:—No international standard pure substance available.

Function:—It participates in protein and fat synthesis and also concerned with biological acetylation such as formation of acetyl choline and detoxication of some drugs. It is Anti grey factor in rats.

Deficiency:—Causes "Burning feet syndrome"; Dermatitis bleeding from nose; grey hair and degeneration of nerve fibres in spinal cord.

Requirements:—Not yet determined.

(6) *Biotin*:—(Vitamin H; Coenzyme R.).

Source:—Liver; yeast; yolk of Egg; milk; molasces grains, nuts and vegetables.

Unit:—No international standard. Pure substance available.

Function:—exact role played by this vitamin is not yet known. An interesting feature about biotin is its reported presence in excessive amounts in cancerous tissues.

Deficiency:—leads to Dermatitis; loss of hair, mental disturbances, atrophy of lingual papillae with palor of entire tongue.

Requirement:—not yet determined.

(7) *Folic Acid*:—(Vitamin B10 & 11):—Pteroyglutamic acid.

Source:—In all green leaves including grass also found in animal tissues especially liver; kidney; yeast; milk.

Unit:—No international standard. Pure substance available.

Function:—It is necessary for proper functioning of the haemopoeitic system, formation of erythrocytes, leucocytes and thrombocytes. It is also implicated in the metabolism of tyrosine.

Deficiency:—gives rise to nutritional macrocytic anaemia including the tropical, pregnancy and macrocytic anaemia of pregnancy sprue and sprue like tropical diarrhoea.

Requirement:—not yet determined.

(8) *Cyano Cobalamine* (Vitamin B12).

Source:—Liver, fermentation liquors, milk.

Function:—essential for normoblastic erythrocyte formation and an important growth factor.

Deficiency:—Severe macrocytic anamia.

(9) *Inositol*:—

Source:—Liver; yeast; muscle tissue (hence called muscle sugar).

Function:—Responsible for gastro-intestinal motility; an important factor for nutrition being concerned in fat metabolism. It is also considered as an "Anti-Alopecia factor).

(10) *Choline*:—

Source:—Lecithin and phosphatids of nervous tissue.

Function:—plays an important role in fat metabolism. Prevents decomposition of fat in liver and clears off decomposition products of fat if already formed. It also protects liver parenchyma from destruction.

(11) *Para Amino Benzoic Acid.*

It is an "Anti grey" factor in some species and has been successfully employed in the treatment of typhus and Rickett Sial diseases.

Explanatory note:—Although Inositol, choline and P.A.B. acid are usually included under Vitamin B Complex, there is

some doubt as to whether they should be more accurately claimed as "essential metabolites"

The following disorders of nervous system are stated to have been caused by deficiency of some members of Vitamin B Complex as a result of research work under the auspices of "Nutritional clinics of New York".

B-1. .. forgetfulness, difficulty in orderly thinking, ideas of persecution, insomnia, degeneration in cranial and other nervous structures.

B-2. .. mental depression, visual disturbances, mild mental confusion, inability to concentrate and perform mental tasks.

B-6. .. epileptiform convulsions, weakness insomia, irritability.

Niacin. .. depression, apprehension, anxiety, irritability; later loss of memory, mania, delirium, hallucination, dementia.

Research is continuing and the names vitamin B12 and vitamin B14 have been tentatively assigned to apparently "new" growth factors at present under investigation.

Daily Intake of Vitamins Recommended by Food and Nutrition Board, National Research Council, U.S.A.

	Calories	Vit. A Int. Units	Vit. B^1 mg.	Ribo-flavin mg.	Nicotinic Acid mg.	Ascorbic Acid mg.	Vit. D Int. Units
Man (70 kg.)							
Sedentary ...	2,400	5,000	1·2	1 8	12	75	
Moderately active ...	3,000	5,000	1·5	1·8	15	75	
Very active ...	4,500	5,000	1·8	1·8	18	75	
Woman (56 kg.)							
Sedentary ...	2,000	5,000	1·0	1·5	10	70	
Moderately active ...	2,400	5,000	1·2	1·5	12	70	
Very active ...	3,000	5,000	1·5	1·5	15	70	
Pregnancy (latter half)	2,400	6,000	1·5	2·5	15	100	400
Lactation ...	3,000	8,000	1 5	3·0	15	150	400
Children up to 12 years							
Under 1 year ...	110	1,500	0·4	0·6	4	30	400
1 to 3 years ...	1,200	2,000	0·6	0·9	6	35	400
4 to 6 years ...	1,600	2,500	0 8	1·2	8	50	400
7 to 9 years ...	2,000	3,500	1·0	1·5	10	60	400
10 to 12 years ...	2,500	4,500	1·2	1·8	12	75	400
Children over 12 years							
Girls 13 to 15 years	2,600	5,000	1·3	2·0	13	80	400
„ 16 to 20 „ ...	2,400	5,000	1·2	1·8	12	80	400
Boys 13 to 15 „ ...	3,200	5,000	1·5	2·0	15	90	400
„ 16 to 20 „ ...	3,800	6,000	1·7	2·5	17	100	400

(C) *Vitamin C* (ascorbic acid).

Source:—Fresh fruit; tomato, orange; lemon; mango, Lichis, Pine apple etc. milk, egg, meat.

Unit:—Equivalent to the activity of .05 microgram of ascorbic acid.

Requirement:—50-70 mgms.

Function:—Antiscorbutic, helps formation of intercellular colloid bodies, of capillary wall, cartilage and matrix of Bones; repair and healing of tissues; organisation of blood clot; maturation of R.B.C. and a detoxicating function.

Deficiency: Leads to scurvy—capillary bleeding, allergic conditions, ulcers of stomach and microcytic anaemia.

(D) *Vitamin P.* (Hespiridin)—Occurs naturally with Vitamin C in fresh fruits particularly lemon. It helps in maintaining the capillary permeability and its deficiency leads to purpura and spontaneous capillary haemorrhage.

(5) *Mineral Substances*:—The following mineral substances are most important.

(1) *Calcium*:—Chief constituent of bones and teeth; controls rhythmic activity of heart and contractility of muscles. daily requirements is 1 gm. per day and 1.5 for lactating mothers, deficiency leads to tetany.

(2) *Phosphorous*:—Constituent of bones and teeth, necessary for cellular activity and muscle metabolism. Daily requirement is 1 to 1.5 gms. Deficiency causes stunted growth.

(3) *Iron*:—Constituent of haemoglobin and nulei of cells, acts as oxygen carrier to the cells. Daily requirement is 15 mgms. Deficiency causes anaemia.

(4) *Iodine*:—Constituent of thyroid gland, helps oxidation process in the body. Daily requirement is 1|1000 mgm. Deficiency causes goitre.

(5) *Sodium Chloride*:—Maintain osmotic pressure in blood and other tissue fluids; essential for maintenance of ph Ion concentration. Deficiency leads to cramps, marked general weakness, mental lassitude, dyspnoea on exertion, heat exhaustion. Daily requirement is 10-12 gms.

(6) *Water*:—70% of body weight is made of water 50% inside the cells, 15% in tissue fluids and 5% in blood; sensation of thirst is adequate guide to the need of water. Daily requirements is $1\frac{1}{2}$ to 2 gallons for average working man.

Energy Value of Food:—(Calories). Protein, fat and carbohydrate yield necessary energy on oxidation which is

utilised for muscular work and maintaining body temperature. Heat energy is expressed as a common measure to express total requirements and calorie is the the unit of heat employed for the purpose. Thus calorie is defined as the amount of heat necessary to raise the temperature of 1 gm. of water through 1°C from 15°C to 16 °C.

Fuel Value of Food:—Each gm. of protein when combusted yields 4.1 calories, Fat 9.3 calories and carbohydrate 4.1 calories.

Basal Metabolism:—It is the amount of energy output of an individual at perfect bodily and mental rest usually 12 to 18 hrs. after a meal.

Calorie Requirement:—40 calories per square meter body surface for man and 38 for that of a woman. An average man has got 1.77 to 1.83 square meter body surface so hourly basal energy output is 71 calories per hour and total calories required to maintain basal metabolism is 1704. (71×24). Thus a man requires 1800-2000 calories to maintain weight and body temp at rest.

Man Value and Family Co-efficient:—In a mixed population variations in age, sex; height etc. occur so widely that it becomes difficult to lay down any standard requirement per head. So standard individual is taken as a unit and average normal adult man is taken as one unit and woman 0.83. Family co-efficient is the scale drawn to represent relative energy requirements of various members of the house hold in terms of such unit expressed as man value. So by man value is meant relative energy requirement of various individuals taking that of an average adult man as one unit. Different fractions for different members of the family expressed in comparison to the unit is known as family co-efficient.

Protective Food:—Protective foods are those which help in protecting the body from invasion by various organisms (Infection) by contributing to the increase of natural body resistance and growth by replacement of wear and tear. These include—

(1) *Proteins*:—Complete proteins (food containing essential amino acid in requisite proportion) abundantly found in milk, cheese, meat, egg, Liver and fish.

(2) *Mineral Salts*:—Sodium, calcium, Iron, copper, Iodine are indispensable in daily dietary though potassium, magnesium are also essential for cell metabolism, for maintenance of alkalinity of tissue fluids and preservation of skeletal structure.

(3) *Vitamins*:—A.B.C.D.E. are necessary for proper functioning and maintenance of normal health, growth and tissue metabolism.

(4) *Water*:—To maintain tissue fluid and circulation.

Balanced Diet:—Balanced diet is a satisfactory diet which consists of a combination of foods in sufficient quantity and in correct proportion to each other so as to provide not only estimated daily number of calories but all the needs of the body to maintain health. A Balanced diet should therefore contain all essential elements of food (Proximate principles) in proper proportion and quantity, to replace natural wear and tear of tissues, to produce necessary amount of calories, to supply enough nutrition for growth. It should also satisfy taste and desire without being bulky. It should further be easily digestible, assimilable and be available for long continued use.

Composstion of well Balanced diet:—

(1) Mixed diet.

Dhenki husked Rise	6	ounces
Coarse Atta ..	4	„
Dal	4	„
Ghee and Oil ..	2	„
Fish and meat ..	1	„
or Eggs ..	2	„
Vegetable unleafy	4	„
Vegetable leafy ..	4	„
Milk	8	„
Fruit Seasonal ..	2	ounces
Sugar and glucose	2	„
Salt and Condiment ..	1	„

2708 calories

(2) Vegetable diet.

Raw milled Rice	10	ounces
Bazra ..	5	„
Milk ..	8	„
Dal	3	„
Vegetable nonleafy ..	6	„
Vegetable leafy	6	„
Oil and Ghee ..	2	„
Fruit ..	2	„
Salt and Condiment ..	1	„

2600 calories

Principles of Dietetics:—The caloric value sufficient to provide requirements of basal matabolism of an average adult is 71 C per hour so 71×24=1704 C. But when the person is up and about caloric requirement is B.M.R+30% =92 calories. The calorie requirements of man vary according to the work done by an individual.

Thus:—

(1) For 8 hours sleep—(at basal rate) 72×8=576C.
(2) For light work—75C per hour=total 2600-3000C.
(3) For moderate work—75-150C per hour=3000 to 3400C.
(4) For heavy work—150-300 per hour=3400 to 4000.

The average woman requires 15 to 20% less food than man. Children over 12 require as much as an adult. The energy value of food purchased and food absorbed and assimilated differs as a loss occurs during preparation, cooking and digestion of food. Further loss occurs by escape of absorption and elimination in faeces. This loss is greater in vegetable diet due to cellulose contents so it is usual to deduct 10% from the theoretical value of diet for this loss. Therefore theoretical yield of 1000 calories would provide only 900 calories.

Daily Diet for Average man:

(i) *Energy*:—The caloric requirement is calculated from findings of the caloric need for basal metabolism to be determined from body surface area roughly estimated as 40 calories per square meter surface per hour taking 1.75 square meter as average surface area. Thus:—

8 hours sleep (B.M.R. 40c×1.75=71c=71×8 ..	568c.
8 hours up and abuot at 30% higher—92=92×8 ..	736c.
8 hours moderate muscular work—B.M.R.+1000 ..	1568
	2872
Loss by cooking, digestion, excretion @ 10% ..	278
	3150c.
Roughly	3000.c

So to get energy value of 3000 calories from absorbed food we are to take 3400c from the food purchased.

(ii) Proteins 75 to 100 gms. (Preferably half animal protein.
(iii) Fat 75 to 100 gms.
(iv) Carbohydrate 400 to 500 gms.
(v) Inorganic Salts.
(vi) vitamins.
(vii) water 2-4 pints.

N.B.:—100 gms. is equal to three and half ounces.

Standard diet for an average adult.

	Proteins.	Fat	Carb.	Calories.
Light Work ..	123	46	377	2445
Medium Work ..	127	52	509	2868
Hard work	165	70	565	3362

Diet for Pregnant and Lactating Mother:

In addition to well balanced diet adequate minerals particularly extra calcium and phosphorous are to be supplied liberally with additional quantity of vitamins B_1, B_2 complex, D and E. As milk is poor in vitamin D content yeast and germinating gram can be added with advantage. The caloric requirement for a pregnant mother is 3200 to 3400 calories and that of the lactating mother 3600 to 3800 calories.

Diet for Pregnant mothers—

Rice 4 ounces
Atta 4 ounces
Dal 2 ounces
milk 24 ounces
Fish 3 ounces
Vegetable leafy 4 ounces
Vegetable non leafy 4 ounces
Oil and ghee 1½ ounces
Fruit 2 ounces
Sugar 2 ounces
Salt and condiments 1 ounce
Water 3 to 4 pints.

Diet for lactating mothers—

Rice 5 ounces.
Atta 5 ounces.
Dal 3 ounces.
Milk 32 ounces.
Fish 4 ounces
other items as for Pregnant mothers.

During 1st three months protein in take should be reduced as constitutional disturbances are more common during this period which can be done by reducing Rice and Atta and increasing the quantity of milk. Similarly meat often produces extra strain on the Kidneys during this period and should better be taken in moderation. For lactating mothers 10-12 ozs. extra milk to be added.

CALORIC VALUE OF IMPORTANT FOODS.

Articles of diet:	*Quantity.*	*Calories.*
Atta	1 ounce	99 to 102
Barley	„	106
Bread (wheat)	„	73
Butter	„	224
Cheese	„	100
Chhana	„	76
Dal	..	100
Fish	„	25 to 50
Ghee and oil	„	264
Egg	„	46
Fruits	„	25
Vegetables (leafy and non leafy) ..	„	25
Rice	„	98 to 105
Sugar and gur	„	100 to 115

COMPOSITION

OF PRINCIPAL FOODS (*Per ounce*).

Articles of diet:	*Prot.*	*Carb.*	*Fat.*	*Salts*
Atta ..	3.4	20.1	0.8	3.85
Barley ..	2.4	22.9	0.5	3.0
Bread ..	2	15	0.35	1.3
Rice (unmilled)	1.9	25.6	0.24	0.5
Rice (milled)	1.6	22.5	0.1	0.5
Pulse ..	5 to 7	15 to 17	4.5 to 15	7.1
Egg (duck) ..	3.9	..	3.2	1.3
Egg (hen) ..	3.8	..	2.4	1.0
Fish ..	4.6 to 5.6	..	1.2 to 3	1 to 1.5
Vegetables ..	1.6 to 2.5	1.5 to 4.6	0.8 to 2	..
Fruits ..	1.3 to 6	5 to 23	1.4 to16	..

Barley ..	13%	71%	1.2%	.. ..
Cocoanut ..	4%	13%	41%	A, B, C, Ca, Fe. Ph.
Dabwater ..	.1%	33%	.29%	B Complex
Chestnut ..	4.47%	33%	.29%	„
Groundnut ..	25%	15%	40%	„
Walnut ..	15%	12%	15%	„
Potato ..	2%	20%	16%	B, C, K, Ca, Fe, Ph.
Soyabean ..	45%	20%	20%	A,B,C,E,K Ca, Fe, Ph.

Cocoa:—1.3 thiobromine and 50% fat.

Coffee:—1% caffeine and 13% fat.

Tea:—1.5 to 5% caffeine.

Egg (White):—water 85 to 88%. Protein 10 to 13% lecithin, fat, glucose, cholesterol, soaps and mineral salts 0.7%.

Egg (Yolk):—Water 47%; Protein 15.6%; Fat 23%; phospholipides 10.5%; cholesterol 2% and mineral salts 7%.

Vitamins in the egg are A, B, B2 and D.

Rationing of Food:—

It is a planned system of control by which essential items of all the food stuffs produced in the country are collected, stored and made available on an equitable basis to the people according to the requirements of the locality.

The rationing system was introduced in 1943. All the areas are not rationed. Some are under full rationing, some under modified rationing while others are not rationed at all.

The present Ration scale as is inforce in rationed areas, is given below:—

Rice eater (Per week)

	Adult. Sr. ch.	Child. ch.	H. Manual. Sr. ch.
1. Rice	1 5	11	1 5
2. Wheat Products ..	11	10	2 3
3. Sugar	3	3	1

Wheat eater (Per week)

Wheat Products ..	2 sr.	1 sr.	3 sr.	8 ch.
Sugar	3 sr.	3 ch.	1 ch.	

Preservation of Food: The various methods are as follows:

(i) *Canning*:—Food is boiled, and sterilised and sealed in vacuum by exposure to high temperature with subsequent exclusion of air to prevent contamination.

(ii) *Refrigeration or cold storage*: It is the best method as it prevents bacteria to develop and multiply, does not alter food value, do not impart any new taste or interfere with natural flavour.

(iii) *Chemical Preservation*: by boric acid, borax, Benzoic acid, formaldehyde, Sulphur dioxide, flourine compds.

(iv) *Drying*: as in the case of milk, meat, onion, potato, cabbage etc. by dehydration.

(v) *Smoking*: Only done for meat and fish.

(vi) *Salting and Prickling*: done by salt (18-25% solution) and vinegar.

(vii) *Oiling*: Green mangoes are preserved in mustard oil and spices.

(viii) *Gas storage*: By Carbon dioxide gas.

Food Adulteration: Adulteration means deliberate substitution of articles of food by another so as to alter its composition and constituents.

DISEASES ASSOCIATED WITH FOOD:

(a) *By contamination from dust and flies*:—Typhoid, Paratyphoid, cholera, dysentery, diarrhoea etc.

(b) *Unwhole some food, adulterated or Preserved food*:—Food allergy shell fish, Prawn mushroom.

(ii) Chemical contamination by arsenic lead, copper, Zinc etc.

(iii) Bacterial food poisoning—Infective and toxic.

(iv) Food intoxication—Epidemic dropsy and Lathyriasis.

(c) *Parasitic infection in food* (Meat) Tuberculosis; Trichinosis, cysticercosis.

(d) *Dificiency diseases*: (i) Protein deficiency causing nutritional oedema from hypoproteinemia.

(ii) Vitamin deficiency, causing—Scurvy, Rickets; osteomalacia, xerophthalmia keratomalacia; Pellagra,

(4) Iron deficiency—causing anaemia.

(e) *Unbalanced diet*:— (Overeating)—Indigestion, obesity and arteriosclrosis.

Methods of food Infection:—(1) Infected animal being used as a food. (2) Contamination by specific organisms from the excreta of infected man and animals. (3) Contimination by chemical substances from metals used in canning process as soldered tin, copper, lead, zinc from galvanised Iron receptacles, antimony from cheap enamel vessels etc. (4) Unprotected food by direct handling.

Food Poisoning:—The term "food poisoning" is commonly restricted to Gastro-enteritis due to bacterial infection of food and drink. There are three types.

(1) *Infectious type*:—From contaminated food like meat, fish, eggs, milk, stored food. The infection takes place by living bacteria present in the food, common organisms concerned are salmonella group; Enteritis, typhomurium (Aertycke). Proteus Vulgaris, clinically characterised by vomiting, diarrhoea, raised temp. etc. terminates in rapid recovery or cholera like death.

(2) *Toxic type*:—From ingestion of Preformed poisonous substances as a result of past bacterial multiplication in the food; toxins are already formed in the food by bacterial action. Foods concerned are tinned meat or fish, organisms concerned are staphylo aureus, proteus, clinically characterised by marked vomiting slightly raised temperature and purging. Rarely proves fatal.

(3) *Botulism*:—Caused by anaerobic spore bacilli (cl. botulinum) proliferating in food. Foods concerned are tinned foods, sausages, canned fruts, preserved prickles, can also take place by soil contamination of food clinically characterised by low temp, vomiting, paralysis of ocular muscles (ptosis, diplopia; loss of accomodation etc.). Usually ends fatally within 4-6 days or slowly recovers in 6 to 8 months.

Special Articles of Dietary:—

MILK

Milk is the best single food to produce growth and nutrition. It contains essentials of a balanced diet. Its quality of protein is very good and held in colloidal suspension: Fat is held in emulson and has a high calcium content and rich in some vitamins. It is palatable and most easily digestible. But as a sole article of diet for an adult milk is poor in Iron and some vitamins. It has too much water and very little roughage.

Composition:—Milk contains proteins in colloidal suspension, Fats in emulsion; inorganic salts in solution, vitamins, phosphatids, enzymes, antibodies. Its sp. gravity is 1025. Protein 3.5% of which caseinogen forms 3%. Lact globulin 1% and Lact albumen .04%. Fat in the milk are glycerides of butryic Palmitic and stearic acid, carbohydrate in the form of Lactose. Mineral salts found are sodium, calcium, potassium in combination with chlorine, phosphoric acid, traces of Iron. Enzymes are amylolytic, proteolytic and lipolytic. Large and small mono and multinuclear cells are also present besides eosinophiles and large vacuolated cells (3,30,000 per c.c.).—

	Protein	Fat	Carb (sugar)	water	Salts
Human	.. 1.7	3.4	6.4	88.2%	0.3
Cow	.. 3.45	3.7	4.7	87.4	0.75
Goat	.. 4.35	4.63	4.22	86.04	0.76
Buffalo	.. 4.75	7.7	4.45	82.3	0.8

Human milk vs. Cows milk:—Human milk contains less of total protein, about the same lactalbumen but less in caseinosen, contains more sugar in the form of lactose, and more iron. It also contains antibodies and is rich in enzyme diastase.

Disadvantage of milk:—It is readily decomposed. Bacteria grow and thrive well in it, of all the food staff milk is most difficult to harvest, handle, transport and give delivery in a clean, fresh and satisfactory condition.

Effect of Heat on milk:—On boiling.

(1) Protein is altered. At 60C for half an hour, Lact albumen coagulates but caseinogen is made more digestible.

(2) Fat emulsion is destroyed, globules coalesce together.

(3) Partial keramalisation of lactose occurs.

(4) Calcium, phosphorous, magnesium salts are precipitated and a portion of citrate lost.

(5) Vitamin C is lost and partial loss of vitimin B occurs.

(6) Enzymes and all micro-organisms are destroyed.

N.B. All pathogenic organisms are killed at a temp of 60.C if milk is heated from 1-20 minutes depending on the nature of bacteria. Tubercle bocilli is killed in 20 minutes most others in 10 minutes.

Pasteurisation of milk:—It is the special heat treatment of raw milk. It consists in heating and raising the temperature of milk in a minute or two to 145° 150°F (63° to 65°c), holding at that temperature at least for half an hour, then rapidly cooling it and bringing down the temperature to 55°F.

Advantages:—The heat of Pasteurisation does not alter the taste and appearance or digestibility of milk, does not appreciably reduce the food value except that there may be a diminution of vitamin C. The process tends to make curds softer and casein easily digestible. Pasteurisation does not destroy all bacteria which can only be done by sterilisation and boiling but it is sufficient to kill common disease producing bacteria likely to occur in milk such as, Typhoid group; cholera; dysentery, T.B. etc. It also inhibits lactic acid bacill and prevent souring of milk for 24 hours.

Pasteurisation cannot improve dirty stale milk but affords protection and prevention of milk borne infections. Finally it can be said that it is the simplest and cheapest method of rendering, infectious milk safe. Pasteurised milk should be bottled by machinery immediately following the process, kept cold and delivered promptly. The bottles are usually first disinfected by steam or scalding water.

Methods of Pasteurisation:—

(1) *Flash method* (High temp short time method):—The milk is heated momentarily to a temp of 162°F for 15 seconds by steam or electricity and cooled at once to 55°F. The method is cheap and rapid but not entirely dependable.

(2) *Holdng method*:—The milk is treated to a temp of 140°F to 150°F and holding it in a suitable tank at that temperature for ½ hour is cooled to a temp of 55°F by running the milk directly to a cooler. It is finally bottled by a machine.

(3) *Vat method*:—The milk is treated in a double walled vat or a coil in a cauldron by steam to requisite temperature and kept in the vat as a holding device for half an hour. It is then cooled by sending cold water through the double wall or coil. The entire process can be done in one container.

(4) *Final container method*:—The process here is done in bottles by keeping the milk bottles in a water bath or hot air

chamber brought up to the required temp and then cooled. There are several types of machinery for this and is a very simple method

(5) *Continuous flow method*:—Milk is heated first and then allowed to run continuously through a series of tanks or coils or metal tubes. By adjusting the rate of flow treated milk remains for desired limit in the apparatus and cooled subsequently.

Test of Pasteurisation:—(Phosphatase test)—This is a colourimetric test to estimate the efficiency of Pasteurisation. Pinciple of the test is destruction of phosphatase enzymes by requisite temperature of Pasteurisation. If the milk is treated to a lower temperature and for a shorter period the enzyme remains in a greater percentage to give a positive test.

N.B.:—In Calcutta (co-operate milk supply depot at Bow Bazar). 8 gallon cans are used for conveying milk from the sources where proper straining, filling and sealing is done before the milk reaches the Pasteurisation depot. cans are kept sterilised by steam and kept covered after use.

Milk Borne Diseases:—Various types of infection are conveyed by milk and milk products. These are—

(1) Epidemic diarrhoea or Gastro enteritis conveyed by improperly handled and stored milk.

(2) Enteric group of fevers—usually by carriers.

(3) Cholera, Bacillary dysentery—by dust and flies contaminating the milk.

(4) Malta fever—Infection by brucella abortus, transfered to man from goats.

(5) Scarlet fever, Sore throat, Diphtheria—by a carrier handling the milk.

(6) Tuberculosis—from infected cow.

Characters of milk borne Epidemics:—(1) Explosive outburst with a rapid rise to a peak and gradual decline. (2) Persons drinking raw milk are affected mostly. (3) Circumscribed to the area of distribution of the infected milk.

Improevment of milk supply:—This can be done by—

(1) Educating the goalas by propaganda and practical demonstrations through social workers and public health staff.

(2) Improvement of breeds, maintenance of healthy cows free from disease; stopping excessive and indiscriminate slaughter, increasing number of cattles per hundred and increasing the area of grazing grounds.

(3) Construction of clean cow sheds.

(4) Hygenic way of milking by clean milkers viz. clean milking in a clean fly proof room after washing the abdomen, and udder of the cows, tail having been kept tied away.

(5) Collection in clean vessels after straining.

(6) Distribution after Pasteurisation in city diaries.

Adulteration of Milk:—Commonest adulterants are (1) addition of water (2) removal of a portion of fat (3) adding of skimmed or condensed milk (4) adding of cane sugar, or batasha (5) addition of starch, Flour and arraroot (6) mixture of milk of different animals.

The addition of water may be detected by reduction of nonfatty solids—if it falls below 8.5% and removal of fat can be detected by reduction of fat content below the legal standard of 3%.

Milk Injury:—Children aged over a year if fed continuously on milk receives less iron so becomes weak and anaemic. The child also become flabby due to consumption of more water in the milk. The above manifestations are termed not too correctly as milk Injury. This can be cured by extra Iron containing foods viz.—Egg, fish, meat etc.

Milk Products:—

(1) *Standardised milk*:—Milk is standardised by adjusting it in such a way as to contain 3.7% fat by adding or subtracting the cream (mixing of buffalo and cows milk).

(2) *Reconstituted milk*:—Condensed or dried milk when reconstituted to the equivalent composition of fresh milk by addition of water and vitamin C.

(3) *Homogenised (viscolised milk)*:—It is so made that fat does not separate out and does not rise to the surface as a cream on standing.

(4) *Dried milk (Milk Powders)*:—It is 7-8 times more concentrated than milk but is deficient in vitamin C. composition—Protein 28%, Fat 25 to 28% Sugar 34 to 40%.

(5) *Condensed milk*:—It is three times concentrated from which it is made and is preserved with 40% sugar, composition—Protein 8%, Fat 12%, Sugar 16.

Preparations of Milk:—

(1) *Butter*:—Fat 83%, casein 1% Sugar 1%

(2) *Ghee*:—Are milk fats with a high vitamin D content. It is clarified butter from which moisture and curd has been removed—(Fat 83.5%—Protein 1%).

(3) *Cream*:—It is the top milk rich in fat (60%).

(4) *Cheese*:—Coagulated casein with fat and salt—casein 2'%, Fat 25 to 50%.

(5) *Dahi*:—Produced by lactic acid fermentation. Curds are produced by coagulation of Protein by bacterial action (casein 25%. Fat 2.5%).

(6) *Butter milk*:—Contains more fat and protein than whey.

(7) *Whey*:—Contains almost all sugar, salt, little lactalbumen (.3%) little calcium and vitamin B.

N.B.:—*Margarine*—It is made from refined animal and vegetable fats to which milk is added to give flavour.

Banaspati:—Made from vegetable fat (hydro genated oil) like cocoanut, cotton seed, sasame, sun flower seed. Contain no vitamin A and D.

Inspection of special food stuffs:—

Rice:—Appearance depends on degree of milling, parboiling or polishing. The degree of milling can only be determined by laboratory test for thiamin content (2 microgram per gm.) and phosphorous content. Insect infestation is detected by webs of silky materials produced.

Atta and Flour:—Atta should be greyish white in appearence and that of flour white. Both are of uniform consistency, smell sweet and possesses a bland taste. It should not be rancid, and musty (due to insect infestation when the surface smoothed with a knife in a few minutes heaps are raised on the surface by the mites). The webs of silky material are produced by insects whereas mould infection makes the atta and flour lumpy.

Bread:—A good bread should have a well risen surface, of brownish red colour, an agreable smell and taste. The crust should be thin crisp and unbroken with a bright brownish tint. It should be evenly aerated and free from large cavities. The crumb should be sufficiently moist soft and elastic. There should be total absence of sourness and mustiness.

Milk:—Should not be ropy or slimy—which indicates disease of the udder or B. lactiviscosus infection. Colour should not be blue—which again indicates watering, skimming or

tuberculosis. The taste should not be bad. Laboratory test to determine fat and nonfat solids.

Ghee and Butter:—acidity and rancidity are signs of bad quality. Purity is best determined by laboratory tests.

Fish:—Lean fish---consist of small fibres and contain below 2% fat.

Fat fish:—Consist of medium and large fibre with a fat content of 2.5%.

Inspection of fish:—There should be no evidence of discoloured patches on the skin, when it appears is usually first seen along the backbone. The eyes should be prominent, clear-bright and transparent and not sunken, collapsed and dull. The gills should be uniformly bright red or pink and not muddy or dark in colour (to be verified after washing) on palpation it should be firm, stiff and elastic to the touch so that when it is held flat on hand by the head tail should not drop (applicable to medium sized fish). It should not feel soft or pit on pressure, skin to be intact and scales not easily detachable. If not eviscerated a sound dead fish sinks in water while an unsound fish floats belly up. A fish is to be rejected if on cutting the fish blood runs out as a dark red or dark tarry liquid and a disagreeable odour of decomposition is felt.

Diseases associated with fish:

(i) Allergy from Prawn, lobster, shell, oyster etc.

(ii) Dibothrio cephalus latus. (Fish tape worm).

(iii) Typhoid from oysters grown in infected water.

(iv) Food Poisoning from ingestion of Poisonous fish viz. —Tetradon Reticularis.

Eggs:—Inspection for colour, Pigementation, cracks or any sealing. The Soundness of egg is determined by two tests.

(i) *Floating tests*:—A Sound egg when placed in a vessel containing 10% Sodium chloride slowly sinks while a bad egg floats.

(ii) *Candling*:—done by holding an egg against a Candle, when a fresh egg appears uniformly pink and translucent and a bad egg shows cloudy dark patches or even opaque owing to gases of decomposition.

Early decomposition of egg could be prevented by smearing the shell by wax, gum, lime, lardoil, or by keeping it in silicate silution. Refrigeration is very good.

Meat:—Healthy meat should have a natural firmness and elasticity, an uniform colour, a marbled appearence (due to ramifications of little veins surrounded by fat among the muscles). The decomposed meat has a disagreable and unpleasant smell which can be tested by plunging a knife or skewer into its substance and withdrawing it as the decomposition starts first in the interior. The juice thus taken out should be reddish and acid in reaction.

Inspection of live animals:—Signs of illness of an animal are thin body; rough skin; hanging head, dull eyes; occasional shivers, quick laboured breathing, dribbling of saliva, nasal discharge, diarrhoea (watery dung with blood and mucus). Raised temperature etc.

Inspection of Carcass:—Head including tongue and glands should be examined. Cheek muscles to be incised by an incision parallel to the lower jaw for evidence of actino mycosis, glandular tuberculosis, foot and mouth disease, Stomach, spleen and Intestine mesenteric glands for exudate and glands. Liver for lumps (T. B. or hydratid) and bile duct for flukes. Lungs for tuberculosis. Heart and pericardium particularly base of the heart as it is a common site for tuberculosis and cysticercosis. The udder to be examined for ulcer and disease particularly the base and the teats with Supra mammary glands.

If there is an evidence of generalised infection the carcass is to be condemned but if localised, the affected organ or a portion of the carcass with continguous portion is to be condemned.

Disease associated with meat:

(1) Helminthiasis:—

(a) T. Saginata (Measly Beef).

(b) T. Solium (Measly Pork).

(c) Trichinella spiralis.

(d) Sarcosporidia.

(e) Hydatid cyst (T. echinococcus).

(f) oncho ceriasis.

(2) Other diseases:

Tuberculosis; actinomycosis, Anthrax, gianders. Foot and mouth disease.

Inspection of Tinned Fish and Meat:—This is done under the following heads:—

(i) *Inspection*:—general appearance of label; expiry date; weight; sign of any damage; rustiness and dents; bulg-

ing of ends. (Both ends of the tin should be concave if found convex and bulged indicates gaseous decomposition.

(ii) Palpation:—normally it is a dull feel. If the dull feel of a sound tin is replaced by a springy feel due to loss of negative pressure indicates deterioration. This is tested by putting a little water on the end of the tin can preferably near the edge and carefully perforating it with a sharp instrument. If pressure is negative water is sucked into the hole but if positive a stream of bubbles rises through the water.

(iii) *Percussion*:—normal dull note of a sound tin is replaced by a tympanitic note due to collection of gas.

(iv) *Shaking*:—a healthy tin gives no sound on shaking.

(v) *Laboratory test*:—by bacteriological, clinical analysis and feeding tests on animals.

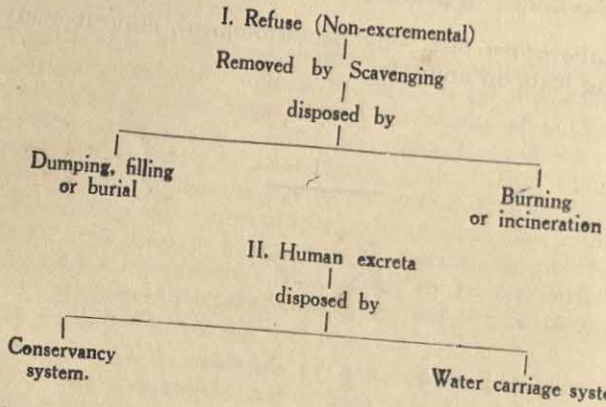
CHAPTER SIX

DISPOSAL OF WASTE MATTERS (REFUSE)

The waste matters for disposal can be broadly classified under two heads:—(i) Refuse and (ii) human Excreta.

Refuse:—It mainly includes all solid waste materials from human habitation. Thus refuse includes dry refuse; garbage; street sweepings, domestic animals excreta.

DISPOSAL OF REFUSE:—



Scavenging:—This means collection and removal of all town and domestic refuse by manual labour.

Refuses are received in dustbins made of corrugated Iron sheet open at both ends and placed on a raised concrete platform at a fair distance from dwelling houses and provided with a cover at the top. The contents are removed daily by specially constructed carts, or lorries in early morning and disposed in the following ways.

(i) *Dumping:*—By this method refuse is utilised in filling up insanitary tanks, reclaiming low lands, Doba etc. Dumping should be done in dry season and under proper supervision often termed as *"Controlled dumping"* which is done in the following way.

(a) The site should be 100-150 ft. away from the nearest human habitation.

(b) sites should preferably be low lying lands. In case of tanks and marshy lands the water is to be drained away first and if the area is very big it can be made smaller by

bamboo matting partitions or earthen dams and each section treated separately in turn.

(c) Filling should start at one end and gradually pushed to other end. Refuse material should be deposited in layers

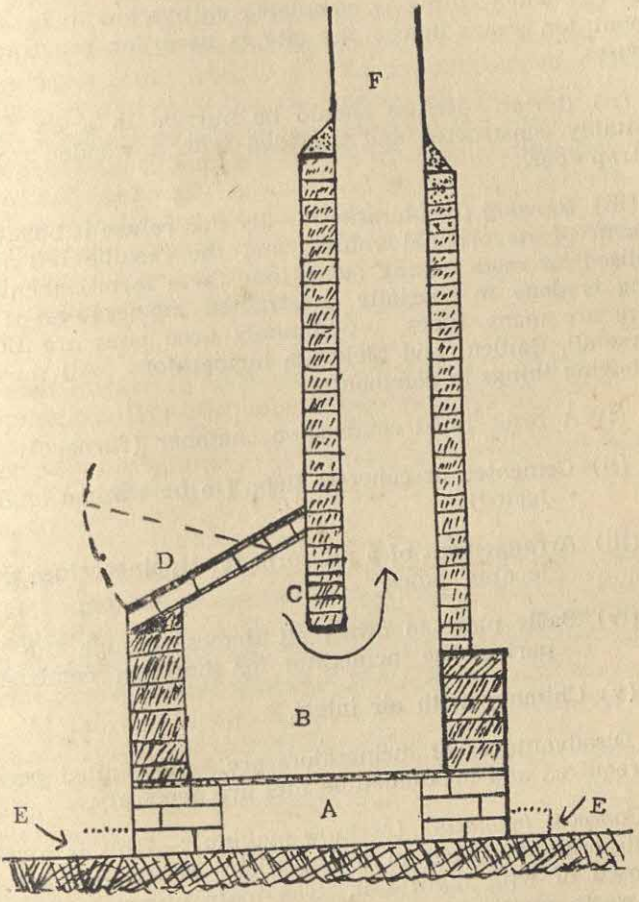


FIG 4

INCINERATOR.

A=Plat form. B=Combustion chamber. C=Baffle wall
D=Filing door E=Air inlet. F=Chimney.

but not exceeding six feet in depth and covered with nine inches of earth, rubbish or cinders.

(d) No refuse should be left uncovered for more that 72 hours.

(e) Each layer of Refuse with each layer of earth should be allowed to settle before the next layer is deposited.

(f) filling should be done two feet above the surrounding area to allow settlement.

(g) when filling is completed cultivation to be done for about ten years before the site is used for construction of houses.

(ii) *Burial*:—Refuse should be burried in a fly proof pit suitably constructed and provided with a wooden cover and a trap door.

(iii) *Burning (incineration)*:—By this refuse is burnt to one fourth of its original volume and the residue left may be utilised for road making (with lime these form cement) Burning is done in specially constructed incinerators of which there are many types. Commonly used ones are Beehive; Horsefall, Bailleul and Meldrum incinerators. All these have following things in common:—

(i) A brick lined combustion chamber (furnace).

(ii) Cemented or concrete floor (to be washed and disinfected).

(iii) Arrangement of a platform for tipping refuse through feeding holes.

(iv) Baffle plate to direct all flames through the hottest part of the incinerator for thorough combustion

(v) Chimney with air inlets.

Disadvantages of incinerators are:—(i) skilled personnel are required and inexhaustible fuel are necessary.

Compost formation (Manure making):—This is a method of disposal advocated in towns where refuse has got to be disposed of with night soil. The main object is to convert the waste matter into humus or compost of high manural value.

At first trenches of suitable sizes are dug and preferably brick lined. Alternatively a bigger trench can be dug and divided into compartments. The collected refuse is separated into two portions—leafy fraction and soil fraction after seiving through a metal sieve to get rid of big stones etc. Two parts by weight of leaves fraction of refuse and one part by weight of fresh night soil is the requisite proportion to make the compost.

The night soil mixed with half its volume of water or sullege is made into an uniform emulsion. A layer of leafy fraction is first spread at the bottom of the trench and soil fraction added. The night soil emulsion, leaf and soil fraction are thoroughly mixed into a homogenous mixture by laddles in such a way so as to prevent the formation of night soil into a separate layer in the trench. The heap of mixture thus made is covered everytime with two inches of the earth. The process is repeated by similar additions till the compost rises two feet above the ground level. The whole lot is then covered with half inch charcoal powder and each lot is allowed to ferment aerobically for 4-5 days after which water is added (2-3 gallons per running foot). The compost is immediately covered with a layer of mud paste. The manure gets ready in three months time and after its removal the trench can be used.

Trench surface of 1000 cft. is sufficient for 10,000 people and can produce 1500-2000 tons of manure per year.

Methods of composting:—(i) Bangalore method (ii) Indore method. (iii) Calcutta Tollygunj method and (iv) Howrah method.

Indore process:—In this process alternate layers of refuse and night soil three inches deep are placed in shallow brick lined pits to a depth of about two feet six inches. If necessary these layers are slightly moistened during filling process. The deposited material is turned at intervals of 14 days. At the end of two months the mass is removed from the pit and staked in rectangular heaps 10 ft. broad at the base, 9 ft. at the top and 3 ft. 6" high and allowed to ripen for a month after which it becomes ready for application to agricultural lands.

DISPOSAL OF HUMAN EXCRETA:—

Conservancy system:—This is adopted in small municipal towns where for economic reason it is not possible to do it by water carriage system. By this system human excreta is removed by manual labour from the inhabited houses. The conservancy system involves the following (a) Construction of latrines and privies in fixed places (b) Arrangement for colection and prompt removal of night soil. (c) Provision for quick and efficient disposal.

(i) *Latrines and Privies*:—Privies are meant for private use where as latrine means a privy for public use and consequently consists of a number of seats for several persons.

Conditions for an ideal latrine:—It should be situated 50 ft away from a well or tank and 10 to 20 ft from the nearest dwelling house. The site should preferably be at a higher level than the surrounding with good access of suns rays. Floor, seat and foot rest should be made of impervious material. The collection chamber should have a concrete or cemented floor with rounded walls and provided with a tarred iron or galvanised bucket and a trap door for removal. It should have a seperate receptacle for collections of urine and ablution water. (cesspit). The super structure consisting of roof and walls can be made with suitable material available.

Types of Latrines:—(i) *Commode or Receptacle latrine*:—It consists of a wooden seat with a bucket, and a self closing lid. Bucket with its contents are removed to the trenching ground or incinerator for disposal.

(ii) *Well or pit latrine*:—A pit or well 6-8 ft deep is dug into the earth with a proper super structure. The excreta falls in the pit where natural septic action takes place.

(iii) *Bored hole latrine*:—This consists of a circular hole with a diamater of 14-16 inches (larger the diamater is better). bored into the earth to a depth of from 10-20 ft. The hole must reach and penetrate two feet below the sub soil water. A wooden rectangular latrine cover or a concrete slab. (Squatting plate or seat) is placed over the mouth of the hole with an opening in the centre and necessary super structure built on it.

It should be closed when it is filled up to two and half feet from the ground level but can be used again after two months when biological disintegration takes place.

Bored hole latrines are suitable for cooly lines in tea gardens and small villages. The advantages are cheap construction and if properly constructed lasts indefinitely, absence of any risk of fly or mosquito breeding. (These do not breed at a depth of 9 ft from the Surface).

(4) *Trench latrine*: (Shallow):—This system consists of a row of trenches arranged in parallel. Each trench is three feet long, one foot wide and two feet deep and two feet away from its neighbour. These may be provided with screen walls for privacy. The Soda and earth removed in digging each trench should be piled at its head end. Men should use the trench by squatting over it with foot on either side. After the defaecation, excreta should be carefully covered with loose earth. The trenches should be filled in after 24 hours use

and a new row of trenches dug similarly in front of previous row. This is suitable only as a temporary measure during mela.

(5) *Deep Trench latrine*:—Each trench dug is 3 feet deep and length of suitable size, usually 10 feet. The sides should better be rivetted with sand bags, wire netting or bamboo matting to prevent collapsing. (Trench should be 4 ft. 6 inches wide to allow this).

The ground for a distance of 4 ft. all round the trench is dug to a depth of three inches and the loosened soil removed. Strips of oil sacking each 5 feet wide is spread over the prepared areas, the margin of the sacking next to the trench is turned down over the side of the trench to a distance of 6 inches and fastened in position with wooden pegs. The edge of the sacking furthest from the trench is sunk into the ground for a depth of 6 inches. The fly proof wooden super structure with a hinged lid opening is then placed in position over the top. The loose soil which was removed is now mixed with heavy oil and replaced on top of the sacking and well rammed on into a hard impervious layer.

When the contents reach within two feet of the surface of the ground the trench is filled in with earth and covered with oil sacking. In six months time faeces disintegrate and no fouling of the ground occurs. The whole thing can be well maintained for an indefinite period by constructing a hut over it and surrounded by a shallow drain to carry off the Surface water.

(6) *Chemical closet*:—This consists of a seat resting on top of a tank filled with solution of caustic Soda and phenol covered with a layer of crude oil. Soda disintegrates and dissolves excreta. Phenol kills bacteria and oil prevents bad odour. When full the contents are emptied either on land or water. This is suitable for isolated houses, Boats, motor caravans etc.

(7) *Aqua Privy*:—It is a miniature Septic tank consisting of a cylindrical masonry tank or a water tank reservoir (3 ft.×2½ ft.) with a burried tube 2½ feet into it. A platform and a seat is provided on the top. The effluent is allowed to percolate in the soil or taken out in a receptacle and used for irrigation purposes. Water is to be added every time during its use and after use and the venitilating tube is to be kept open to give exit to the gas.

(B) *Collection of Night Soil*—Night soil is collected by sweepers from Latrines and transferred to night soil carts and finally carried to the trenching ground. In the outskirts of

Calcutta the contents of night soil cart are first carried to the night soil depot and then discharged into a main sewer. (Night soil dumping depot is at Tollygunj).

(c) *Disposal of night soil*:—In conservancy system this can be done by:—(i) Trenching (ii) Incineration (ii) composting.

(i) *Trenching*:—The site for trenching ground is selected outside the area of the town and at least one fourth mile away from the nearest dwelling house and 300 feet away from any source of water supply. The ground should preferably be a raised one and be made of light porous soil There should be good road and provision of water for approach and cleaning of the night soil carts. It should be covered with a fly proof shade if possible with arrangements to drain away the surface water.

The method of laying out the trenches are as follows. The selected area of the ground should be of sufficient size to allow working for three years without using any part of the land twice, so that the area can be divided into three plots; each plot used once in three years and the remaining two plots kept under cultivation. Trenches are dug with slope for even distribution and bottom of the trench filled with porous soil. Rapid disintegration of the night soil takes place by the nitrifying organisms in the soil. So mode of action strictly speaking is biological like a septic tank.

Usual measurement for these trenches are 20-30 ft. long, 1 to 2 feet deep, 1 foot wide and placed at a distance of 2 ft. apart.

The night soil to the depth of six inches (4½ inches in rainy season) is filled and covered with excavated earth and one inch lime to inhibit fly breeding and to help disintegration and absorption of faeces. When completely filled an excess of earth is placed in a dome shaped manner and not flush with the surface. The cultivation is started three months after trenching. (Mustard, tobacco, cabbage, sugarcane etc.).

(2) *Incineration*:—The night soil is burnt in a well designed closed type incinerator with the help of street refuse or fuel. Incinerator should be sited within few feet of the latrines. This is very Sanitary.

(3) *Composting*:—See before.

Disadvantages of the Conservancy System:—

(1) Not suitable for big towns.

(2) Not economical as it entails large labour, cattles, cart etc.

(3) Transfer of night soil always cause nuisance with risk of contamination of soil and fly infection.

(4) Epidemic in conservancy cattle often upset the whole work.

The Water Carriage System:—

In this system all liquid waste and faecal matter are carried away through a system of drainage and sewers by the help of water. The water carriage system is divided into two parts:—

(1) House drainage system
Water closet.
Soil pipe.
House drains.
Traps.

(2) Sewers.

The House Drainage System:—

(1) *Water closet*:—It is a sanitary installation for reception of human excreta and then removal through agency of water having a connection with a sewer through soil pipe and house drain. Each water closet consists of a basin and a trap with overhead flushing apparatus.

Varities of closet:—(1) Valve closet (2) wash out closet (3) syphonic closet (4) trough closet (5) wash down closet. Wash down closet is most commonly used. It consists of a short inverted cone with an almost vertical back which dips to the water in the trap for about two inches to form the waterseal. excreta falls directly in the water of the trap and cleansed by a flush.

(*Flushing Apparatus*:—Consists of a storage cistern of about three gallon capacity and placed 4-5 ft. above the closet, on pulling the chain water is discharged by syphonic action.

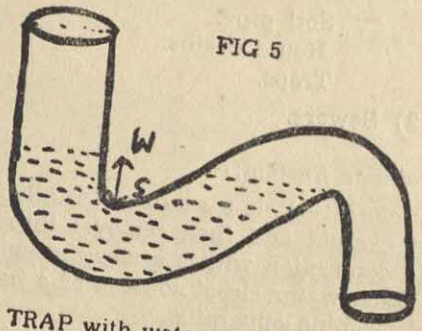
(3) *Soil pipe*:—It is a pipe which conducts excreta from the water closet immediately below the trap to the house drain into which it opens directly without intervention of any trap. It also acts as a ventilator for the house drain by carrying above the roof (by a small pipe) of the building and protected by wire gauge.

(4) *House drain*:—It is an underground pipe to carry away the excreta from water closet received directly via the soil pipe and waste water from the house or compound to the sewer. These drains are fitted with ventilators—inlet near the intercepting trap between the house drain and the sewer, and

the outlet pipe above the roof and protected by wire gauze. (Soil pipe acts as outlet ventilator).

(5) *Traps*:—A trap is a pipe bent on itself in such a way as to retain a certain amount of water in the bend. It is an arrangement in the drain which acts as a barrier to the passage of sewer air and is effected by water seal. The water seal is a column of water in the trap which prevents passage of gas from one side of the trap to the other. It is two to two half inches in length and is represented as the distance between the level of water in the trap and the lowest portion of its concave surface.

FIG 5



TRAP with water steel. (↕ W.S.)

Varieties of Traps:—(1) 'S' or 'P' trap according to shape.

(2) Gulley trap:—to collect rain and waste water, conduct it to sewer or house drain.

(3) Syphon trap:—placed in closet sink of a bath room.

(4) Intercepting trap:—It is placed between the house drain and the sewer (just before it joins the sewer) to prevent the passage of sewer air and rat into the house drain.

N. B.:—The effective part of a trap is the "water seal" as the trap is rendered useless if this seal is broken or removed. This may occur by siphonage and air compression. "When two or more traps discharge into a common pipe, as in the case of several water closets discharging into one soil pipe; flushing of one and subsequent passage of water down the main pipe exerts an aspirating effect upon the air in the lower pipe connections, reducing the atmospheric pressure in these, causing the seal to be siphoned out." Similarly in cases of vertical pipes in high buildings, a discharge down the main pipe may cause momentary compression of the air in lower branches and the seals of traps connected to these may be blown out. In order to preserve equilibrium of atmospheric pressure

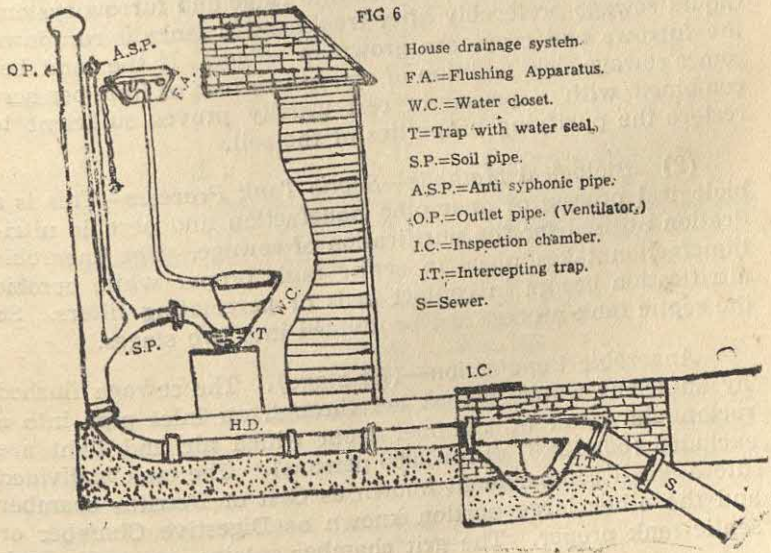
throughout the system and to prevent both siphonage and air compression, a pipe called Antisyphonic pipe is joined to the outlet of each trap either connected to the soil pipe at a point above the highest fitting or carried up specially as a vent pipe.

It will also be seen that there are two divisions of sanitary fittings providing two sets of pipe system. Waste fittings for carrying the rain and waste water and soil fittings for the sewage alone termed the "*Seperate system*". But in modern system of drainage this is considered unnecessary so that outlet of all fittings discharge into a common pipe directly connected to the drain i.e. without intervention of any trap often termed as "*one pipe system*" or '*Combined System*".

(2) *Sewer*:—It is an underground structure in the form of a pipe (glazed stone ware, reinforced concrete pipes, cast iron or steel pipes jointed together) or a brick channel for the removal of waste Water, rain water and sewage. The sewer is laid in a gradient manner in such a way as to get a velocity of self cleansing by gravity (2-3 ft. per second). The sewers require to be well ventilated and is done by vent pipes, hollow gas lamp posts; ventilating shafts or utilising the house drain as a ventilator by omitting the intercepting trap.

N.B:—A Drain is a private property of the owner of the house where as sewer is owned by a public body, a municipality or corporation.

FIG 6



House drainage system.
F.A.=Flushing Apparatus.
W.C.=Water closet.
T=Trap with water seal.
S.P.=Soil pipe.
A.S.P.=Anti syphonic pipe.
O.P.=Outlet pipe. (Ventilator.)
I.C.=Inspection chamber.
I.T.=Intercepting trap.
S=Sewer.

Disposal of Sewage:—

Sewage includes waste matter consisting of human excreta together with liquid refuse from houses, stable-houses and factories. Sullege includes all liquid waste unmixed with human excreta.

Methods of Disposal:—

(A) *Dilution*:—(1) by discharging into the Sea, River or Khal below the lowest ebbtide line, the discharging outlet of the sewer being protected with a valve to prevent river water backing into the sewer.

(2) By discharging into tanks excavated artificially under ground and allowing the effluent to run into lands for cultivation.

(B) *Purification*:—(1) By land treatment.

(2) By biological treatment.

(i) Septic tank process

(ii) Activated sludge process

(1) *Land Treatment*:—This is a natural biological process by which sewage is purified. This is done mainly by oxidising action of the soil bacteria (nitrifying organisms) and partly by the soil acting as a mechanical filter, holding back the various organic matter. The land should preferably be porous and bottom under drained at a depth from 4 to 6 feet and placed 10 ft. apart. The land is divided into ridge and furrow system. Liquid sewage preferably after treatment in tanks is run down the furrows and crops are grown in ridges. If the land becomes sewage sick. addition of one to two tons of lime per acre combined with a period of rest usually proves sufficient to restore the purifying properties of the soil.

(2) *Biological Methods—Septic Tank Processs*—This is a biological process of anaeroibc liquefaction and aerobic nitrification utilised for the purification of sewage. The anaerobic liquefaction takes place in septic tank proper while aerobic nitrification occurs in contact beds or percolating filters. So the septic tank process can be divided into two stages.

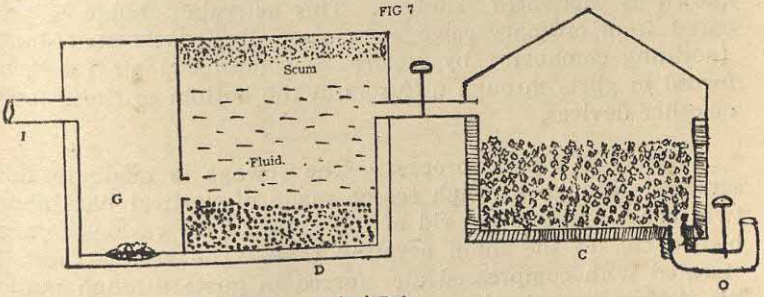
Anaerobic liquefaction—(Ist stage). The sewage flushed by sufficient water is first led through an inlet pipe into a rectangular tank or chamber from which air and light are excluded (60×12×6) ft for 2000 persons). The tank is divided into a small compartment known as Grit or Detritus chamber and the other large portion known as Digestive Chamber or septic tank proper. The grit chamber retains and holds back

the stones, bricks, hard lump of faeces and prevent their entry into the digestive chamber and interfere with the action in the tank. The two chambers are connected through an opening 1 to 1½ ft above the bottom. As 95% of faecal matter floats in water it cannot get into the tank. The bricks stones ets. collected in the grit chamber are removed from time to to time through a specially constructed aperture.

In the grit chamber solid masses of faecal matter are broken down by anaerobic bacteria and the complex organic substances of the sewage are liquefied and broken down into simpler chemical substances. The albuminoid materials, cellulose, fat etc. are split into soluble nitrogenous substances, fatty acids, ammonia etc. This action is also partly continued in the septic tank proper where a scum forms on the surface below which is a clean layer and at the bottom of the tank is collected a fine deposit of organic matter. Ultimate breaking down of organic matter results in the formation of ammoniacal bodies and gases ready to take up oxygen. The effluent is now drawn out of the chamber by an outlet pipe dipping a little distance below the surface of the liquid. The sewage and sludge is allowed to remain in the chamber for a further period (8-24 hours) or longer, givng opportunity for anaerobic bacterial action.

Thus treated sewage is next subjected to further purification in contact beds or percolating filters by aerobic bacteria where the ammoniacal bodies are converted into nitrites and nitrates.

FIG 7



Septic Tank.

I=Inlet pipe. G=Grit chamber. D=Digestion chamber.
C=Contact bed. O=Outlet pipe.

(2) *Aerobic nitrification* (2nd stage)—This takes place in contact beds which in reality are tanks filled with clinkers and gravel (½ to 2 inches). The effluent from the septic tank is distributed and allowed to stand full for a specific time, then emptied and left empty for several hours. Each bed

usually provides a period of eight hours rest after four hours work in order to establish reaeration. The percolating filters are in reality aerating beds and operate on the same principles but the effluent is sprinkled by mechanical device.

In passing through the bed or filter as the case may be the effluent rapidly coats filtering medium and its interstices with slimy organic matter abounding in plentiful bacteria and insect larvae of various sorts. All the conditions for nitrifying action, oxygen, moisture and warmth are found in the interior of such beds. The organic matter are absorbed and oxidised in the interstices of the filter so that nitrites and nitrates are formed. The effluent from filter or beds is apt to contain some humus (fine light organic matter) which is allowed to settle and separated off before discharging the effluent into a stream. Even then the final effluent cannot be depended upon so far infection is concerned so it is always better to disinfect it with bleaching powder (5 grs to a gallon) or chlorine before discharging it into a stream.

N.B.:—*Septic tank latrine*:—It is a latrine built on the roof of a miniature septic tank.

Activated sludge process (*Bio-Aeration*) :—

What is activated sludge?:—If sewage standing in a tank is brought into intimate contact with air so that perfect aerobic conditions are maintained throughout the liquid, the particles of suspended matter after a time flocculate into masses of sludge swarming with microscopic life much as the slimy growth in the contact beds of sand filters. This sludge is known as "activated sludge". This activated sludge is prepared from ordinary sewage in specially constructed tanks (aerating chmabers) by means of compressed air (oxygen) forced in gusts through diffusers at the bottom of those tanks or other devices.

Activated sludge process:—The sewage is made to flow screened through a rough screen made of vertical bars about two inches apart to get rid of the gross solids, various foreign bodies etc, to the main aerating tank. The sewage here is treated with compressed air forced in gusts through porous tile diffusers at the bottom of the tank or other device such as perforated pipes or by means of mechanical agitators or puddles. The sewage is distintegrated and liquefied with formation of fine emulsion.

Next it is passed through a grease collecting chamber where any grease collected at the top of liquid is trapped. The treated sewage is drawn off from the bottom and lead into mixing chamber. Here it is mixed with previously aerated

oxidised into nitrates. The air is then turned off and is passed through a settlement tank where the sludge settles at the bottom and the supernatunt fluid is drawn off for further purification.

The sludge deposited in settlement tanks is returned in part to mix with raw sewage as it enters the aeration chamber and the rest run off to sludge drying beds as it contains 85 to 95% of moisture, where it is dewatered, dried and finally used as a manure for cultivation. Alternatively the activated sludge effluent and liquid sludge may be used by irrigation for cultivation of barren lands. Sludge cake can be made with lime by a special machine and these cakes may be used as a manure or used in filling up waste lands.

N.B.:—Activated sludge system exists in Jamshedpur and B.E. College, Sibpur. In Calcutta system, the sewage from the four main sewers after screening is pumped (Pumping Station at Tangra) into big sedimentation tanks where solids in suspension are deposited, the sludge and a portion undergoes liquefaction anaerobically. The effluent is flowed along open channels to Kulti river bed and the tanks are periodically cleaned out of the deposited sludge. Proposals are now afoot to utilise this sludge as manure.

Surface aeration process (Simplex System):—This is a specially constructed tank in which last three processes of activated sludge process i.e. mixing, final aeration, settlement and separation of activated sludge from the effluent are carried out. In this the mixture of sludge and sewage is aerated by drawing it continually up a tube from the bottom of the tank and spreading it in the form of a fine spray over the surface and bringing it in intimate contact with air.

Sludge Digestion:—In this process the sludge is made to undergo fermentation in special digestion tank at a optimum temperature (75 to 80°F). The fermentation leads to reduction in original volume of sludge and production of large amount of odourless gas (methane fermentation) methane, carbon dioxide with traces of hydrogen, oxygen and nitrogen. The gas resulting from fermentation or digestion can be collected and used for power purposes e.g. running a plant as in Bhatpara.

CHAPTER SEVEN

PREVENTION AND CONTROL OF INFECTIONS

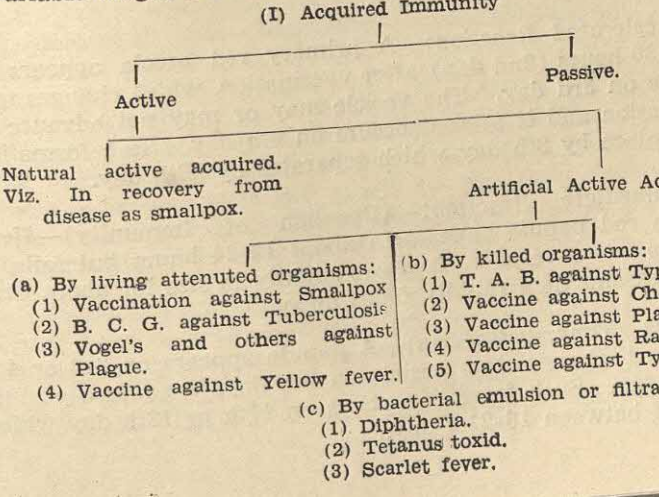
Immunity and Immuno Biological Methods.

Immunity:—It is the non-susceptibility (resistance) of the tissues to infecting organisms under normal conditions.

Natural Immunity:—It is the resistance offered by the body under normal conditions without any external stimulation or previous infection.

Acquired Immunity:—Acquired immunity may be active or passive. In former antiboides are formed due to reaction of persons own tissue in acquiring resistance. In latter the immunity is obtained by introduction from without of immune bodies induced in some other person or animal.

Immunobiological methods to prevent Communicable-diseases:—Active immunity can be acquired artificially by prophylactic inoculation to prevent infection of communicable diseases. This is induced by artificial stimulation by antigen of the bacteria or virus whereby the antibodies are formed due to reaction of persons own tissue in acquiring resistance to infection. Similarly passive immunity can be acquired by introduction from without of preformed immune bodies. Here the tissues of the host do not react in the process of immunity. This is done by injecting serum or blood containing antibodies from outside source viz., immunised animal or convalescent patients. The process of active immunisation is the method of choice as it confers complete protection against diseases for a variable length of time



(II) Passive Acquired Immunity.

(1) By convaltscent sera as in measles.

(2) Antiloxic sera as in tetanus. diphtheria , gas gangrene, scarlet fever.

Antibacterial sera.
(1) Tetanus toxoid.
(2) Meningitis.

Antiviral as in Polio-myeletis.

N.B.:—Antibacterial sera are only of therapeutic value and not of any prophylactic value.

(A) *By Living Attenuted Organisms:*

Small Pox:—Artificial active acquired immunity is obtained against this disease by vaccination (introduction of attenuted vaccine virus).

Vaccination—Primary Vaccination:—This is done before six months after the birth of child though 4th month is the best time for it. Three days after primary vaccination a papule forms which changes into a vesicle wih red areola and umbilication in another three days time. The vesicle changes into a pustule during next three days. The pustule reaches full development in about 12th day after which it rapidly dries up leading to scab formation which falls off by itself on about 20th day. Inspection of primary vaccination is done on 6th, 10th and 21st days.

Secondary Vaccination:—(Modified take)—This is performed at any time after a primary take. The take resulting from a Secondary Vaccination is of three kinds. (i) Acclerated (ii) Immediate (iii) Primary.

Acclerated Reaction:—A primary red areola appears in about 36 hours (2nd day) after vaccination, which changes into vesicle on 3rd day. The vesicle may or may not advance to pustulation and if present occurs on 4th day. Scab formation takes place by 8th day which separates by 10th day.

Immediate Reaction:—(Reaction of Immunity)—Here pinkish red papule appears in about 12-24 hours but fails to develop into a vesicle. It grows slightly in size for about next 24 hours and then rapidly fades away.

(iii) *Primary Reaction:*—A papule appears on 3rd or 4th day which changes into vesicle on 5th day, becomes a pustule on 8th day. Scab formation starts on 11th or 12th day which falls off between 16-21st day.

The modified reactions of secondary vaccination except primary are positive takes. They represent successful vaccination and are expressions of immunity. These serve as an index of protection and its degree and also signify that prior vaccination was successful.

Days afte. vaccination	Primary.	Acelerated.	Immediate.
1	×	×	Papule
2	×	Papule	No Vesicle
3	×	Vesicle	Rapidly fades.
4	Papule	Pustule (if present)	×
5	Vesicle	×	×
8	Pustule	Scab	×
11	Scab	Scab off	×
16—21st	Scab off	×	×
Immunity originally prossessed by an individual.	Nil	Fair	Good

N.B.:—If three attempts fail (done every week) specially with lymph which has successfully vaccinated others and if all precautions have been taken non succeptibility can be certified.

Vaccine lymph and vaccine pulp:—Vaccine lymph is the fluid contents of a vesicle (exudation after vesicle is broken). The vaccine pulp consists of entire vaccine with its contents which is scraped from the vesicle on the skin. The vaccine pulp is used for vaccination as the virus of vaccine (cow pox) is concentrated in epithelial cells.

Preparation of vaccine pulp:—Healthy calves between the age of 1-½ years are selected after a quarantine of 7 days. The abdomen and inner aspect of the thighs are washed with soap, dried and painted with 10% glycerine swab to keep the skin supple. The calf is tied to a table and vaccinated with

current seed lymph (each 2 inches long and ½ inch apart with a scarifier of 4 teeth of 1|5th m.m. in depth total 70 to 80 markings are made) it is allowed to dry and kept bandaged. Inspection for take is made after 48 hours and 20% glycerine is again painted to keep it moist. on 5th day the vesicles are scraped off and vaccine pulp thus obtained is triturated in a grinding machine usually with 4-6 times its weight of 5% sterlie glycerine and distilled water. This fine emulsion is put in cold storage (at 10° below o.c.) for 6 days. 5% phenol is added to reinforce the bactericidal property of glycerine. Bacteriological examination is done to test its purity and sterility and potency. Pathogenicity is tested on rabbits. The purified lymph is finally charged into capillary tubes (sterile) by air pressure (vaccum) and sealed hermetically. Each capillary tube contains about 1|10 c.c. sufficient for vaccination of 2-4 persons. Each calf on average yields 30 gms. pulps (30 c.c.)

(ii) *B. C. G. (Bacille Calmette Guerin)*:—It is attenuted livning bovine micro bact tuberculosis rendered avirulent by artificial cultivation (230 sub-cultures taking about 13 years) through generations on a glycerine bile potato medium. It is useful as a specific prophylaxis against tuberculous infection particularly in cases of those who are exposed to infection. There is ample evidence to prove that B.C.G. is reliable, safe, and sufficiently successful agent in conferring partial immunity.

Methods of administration:—(i) *Oral Method*:—Three doses of B.C.G. are given 10 mgms every other day by mouth to infants during Ist 10 days after birth (before natural infection has occured). Infants born of tuberculous parents are to be isolated. Oral vaccination is uncertain in its effects and no longer recommended.

(ii) *Sub-cutaneous Method*:—1-2 c.c. (1|100 mgm. per c.c.) is given according to the age. This method is risky as it "produces too high a proportion of abscesses both locally and in the regional lymph glands."

(iii) *Intradermal Method*:—0.1 c.c. containing (0.1 to 0.15 mgm of B.C.G.) is injected intracutaneously according to the age by a tuberculin syringe. Multiple puncture method is an intra cutaneous method in which multiple needle punctures are made through B.C.G. Suspensions (5 mgm per c.c.) spread on the skin. This can also be done by placing on the skin tissue paper or thin cellophane moistened in B.C.G. Suspension (20 mgms per c.c.) and then making multiple punctures by a special automatic spring instrument capable of making 40 punctures at a stroke.

Intra cutaneous method appears to be most satisfactory. It is not yet certain how long the conferred immunity lasts, but there is evidence to suggest it lasts from 4-6 years.

N.B.:—The Vole bacillus (murine type of tubercle bacillus) properly administered confers immunity against tuberculosis in human beings and great hopes are entertained about it.

The disadvantages of B.C.G. are—(i) the possibility of the organism regaining its virulence in the human body. (ii) risk of contamination or replacement of the B.C.G. culture by virulent tubercle bacilli from outside, (iii) vaccination often renders the subjects allergic so that tuberculin test can no longer be used to indicate the presence of infection with virulent bacilli.

Tuberculin Tests:—Tuberculin is a bacterial extract from Mycobact, tuberculosis. The tuberculin tests are employed to find out the sensitization of an individual to tuberculous infection. The sensitization is due to some substance obtained from tubercle bacilli during primary infection. These tests are of value in diagnosis. The tests are:—

(i) *Von Pirquets test*:—Two drops of undiluted tuerculin are placed on the forearm 4 inches apart and light sacrification is carried through them. Control through 50% glycerine in skin is done. Positive reaction is shown by erythema, papule or even vesicles within 24 to 48 hours. This test is not employed nowadays.

(ii) *Vollmer's patch test*:—Small squares of filter paper saturated with undiluted tuberculin are fixed on adhesive tapes and applied on skin after cleaning, with removal after 48 hours an area of erythema or induration may be regarded as a positive reaction. It is not very reliable always.

(ii) *Mantoux test*:—This is the test of Choice 0.1 c.c. of pure tuberculin in dilutions of 1 in 10,000 1 in 1000 and 1 in 100 are employed (i.e. 0.01 mgm, 0.1 mgm and 1 mgm). At first 1 in 10,000 dilution injection followed by increasing concentrations are used. Redness, oedema, area of erythema and induration develops in 2-4 days in a positive case.

The mantoux test cannot be regarded as negative unless it has been carried out with a dilution of 1 in 100. This test besides holding an important place in diagnosing tuberculous pulmonary lesions, is also of great value in contact examinations and in mass investigations of apparently healthy persons when preliminary mantoux testing will save unnecessary and more expensive radiological examinations.

(iii) *Yellow Fever*:—5 c.c. of living attenuted virus vaccine (1500 mouse protection units) is given . Immunity devolops in 10-14 days and lasts for 2-4 years.

(iv) *Plague*:—(Vogel and otten)—Vaccination is done by avirulent living culture of plague bacilli. Immunity lasts for six months to one year.

(B) *BY KILLED ORGANISMS*

(i) *Typhoid Fever*:—Vaccine contain—

Typhoid—1000 million killed organism per c.c.

Para 'A'— 500 million killed organism per c.c.

Para 'B'— 500 million killed organism per c.c.

½ c.c. is given followed 7 days after by 1 c.c. (within 10 days of Ist injection). During epidemics 1 c.c. is given as a single dose. Immunity obtained is active which lasts for one year.

(ii) *Cholera*:—Vaccine contains 3000 million of killed organism per c.c. ½ c.c. is given followed 7 days after by 1 c.c. During epidemic 1 c.c. as a single dose. Immunity develops within one week and lasts for 6 months.

(iii) *Plague*:—Haffkin's Vaccine containing 1000 million organisms per c.c. dose is as above ½ c.c. followed by 1 c.c. Various modifications of Haffkin's Vaccine is now used (Sokehy's). Formolised acid casein hydrolysate is very popular and is given in 1 cc. weekly dosage for 2 weeks. During epidemics 2 cc. as a single dose. Immunity gained lasts for 6-8 months.

(iv) *Typhus*:—Wright's and Blanc's Vaccine—1 cc. weekly dose up to a total of 3 doses. Immunity devolops in 4 weeks.

(v) *Rabies*:—Antirabic vaccine is a killed virus vaccine consisting of carbolised suspension of brain tissue containing the "fixed virus" of rabies. The dose of the vaccine depends upon the site, severity and number of bites. The immunity confered is shortlived (3 month). For slight cases (Class I)—2 c.c. daily for 7 days. For moderate cases (Class II)—5 cc. daily for 14 days For severe cases (Class III)—10 cc. daily for 14 days. Immunity obtained is shortlived probably 3 months.

N.B.:—An attenuated living virus vaccine is employed in france but requires supervision in an antirabic institute.

(C) *BY BACTERIAL FILTRATES OR EXTRACTS*:—

(i) *DIPHTHERIA*:—The following are used:—

(a) *A. P. T*:—(Alum precipitated Toxoid)—Here the insoluble aluminium toxoid compound is deposited at the site of injection with gradual liberation of the toxoid so that the antigenic stimulas is maintained for a long period. The dose is 0.2 and 0.5 cc. at 3-4 weekly intervals for the infants and 1 cc. of 3 doses each at 3-4 weekly intervals for the adults.

(b) *T.A.F.*:—(Toxid Antitoxin Floccules). In this a saline suspension of the precipitate of floccules is formed when toxoid Antitoxin are mixed). It is much used for the adults as it gives rise to very little or no reaction and of high immunising value, dose is 1 c.c. of 3 doses each at weekly intervals.

(c) *T.A.M.*:—(Toxoid Antitoxin mixture)—The toxoid is diluted and partially neutralised by antitoxin. Less efficient prophylactic and not much used. Dose—3 doses of 1 c.c. at weekly intervals.

(d) *F. T. (Formol Toxoid)*:—Here the toxin is detoxicated by the action of formalin. It has a high immunising value but may cause reaction in older people. The dose is 5 c.c. of two doses at weekly intervals and is not useful for boys above 10 yrs.

(e) *P. T. A. P.*:—(Purified Toxid Aluminium Phosphate Precipitated) It is a suspension of highly purified toxoid adsorbed on aluminium phosphate and is designed to reduce to a minimum the content of protein and nitrogen compounds. It is the outcome of more recent research and time alone will indicate its full worth in preventing diptheria. The elimination of foreign protein in this new preparation should make it less liable to produce untoward reaction. Dosage is 0.5 c.c. at four weekly intervals (Two doses).

Of the above A.P.T. is mostly used for children and T.A.F for adults.—The best time for immunisation is 1 to 5 years. The time taken for the immunity to devolop is between 6-10 weeks. The duration of immunity is protracted but actual period is not definitely known.

In all cases Schick's test should be done not less than 3 months after the last injection.

Schick's Test:—This is a test for detection of susceptible persons to diptheria and to confirm immunity after immunisation. It thus determines the presence or absence of immunity against diptheria. The test is done by injecting intradermally 0.2 c.c. of the test toxin into the left forearm and 0.2 cc. of the control (toxin heated to 70.c for 5 minutes) in other forearm. The fore arm is inspected after 24 hrs. and 48 hrs. in adults and in both after 7 days. The results are recorded as follows:—

(i) *Positive Reaction*:—Erythema—areola with a raised urticarial wheal in 24-48 hrs. and well marked in 4 days fading away with a brownish colour and disquamation by 7th day. It indicates susceptibility to infection.

(ii) *Negative Reaction*:—No reaction indicating resistance to infection.

(iii) *Pseudo-Reaction*:—In this at both sites there is a definite reaction in 24 hrs.; this subsides more rapidly than true positive reaction and by 4th day there is little to be seen. This is actually a negative result, the lesson being of non-specific nature. This indicates resistance to infection.

(iv) *Combined Reaction*:—Here the reaction is positive in both fore arms within 24 hrs. with formation of a red patch in both forearms but with no areola or raised wheal. The patch on the Control arm fades away on 4th day while that of the test arm proceeds as in positive reaction. The positive reaction in test arm indicates susceptibility to infection and the pseudo reaction in control arm indicates non-specific reaction (due to serum protein). This combined reaction is thus taken as a positive reaction.

Molony's Test:—This is done to test the hyper-sensitiveness to toxin in adults and consists of an intradermal injection of 0.1 c.c. of 1 in 100 diluted formol toxoid. A positive reaction shown by redness, induration within 24-48 hrs. indicates special susceptibility and necessity for reduced dosage or employment of T.A.F. or A.P.T. instead of formol toxoid

Toxoid:—It is a toxin which has been modified by formalin and heat (at 37.c for 4 weeks) to destroy the toxic power but retaining the antigenic power.

M.L.D. (minimum lethal dose)—It is the amount of toxin required to kill a guinea pig weighing 250 gms in 4 days.

Unit of Antitoxin:—It is that amount of anti toxin which neutralises 100 m.l.d.

N.B.:—The presence of 1-100 to 1-40 unit of anti-toxin per c.c. of blood gives a negative result.

(2) *TETANUS*:—Active acquired immunisation is done by injecting tetanus toxoid (T.T.) in 1 c.c. doses of two injections each at the interval of 6 weeks followed in a year by a reinforcing dose of another c.c. repeated at yearly intervals.

(3) *SCARLET FEVER*:—Immunisation is done by injecting an initial dose of 500 skin test doses, increasing to 80,000—100,000 skin test doses in the course of five injections subcutaneously. Immunity develops within two weeks and lasts from 1-5 years.

Dick's Test:—This consists in an intradermal injection of one skin test dose of a potent erythrogenic toxin diluted with saline and contained in 0.2 c.c. with control (same toxin heated to 100.c for one hour). An eyrhtematous patch on test arm in 18-24 hours is a positive reaction and indicates susceptibility to infection.

ARTIFICIAL PASSIVE ACQUIRED IMMUNITY:—

(i) *By Convalescent Serum*:—It is given in measles in dosage of 2 c.c. per year of age, maximum of 10 c.c. of convalescent serum. Passive immunity lasts for 3-4 weeks. Gamma globulins give good results.

(ii) *By Anti-Toxic Serum*:—This is given in tetanus 3000 1.u prophylactic dose intramuscularly in those who were actively immunised, otherwise two further doses of 3000 i-u at weekly intervals.

In scarlet fever passive immunity by antitoxin in dosage 4-10 c.c. subcutaneously. Immunity lasts for two weeks.

In Diphtheria Passive Immunisation is done during an epidemic by injection of 500 to 2000 units of Anti-toxin. Passive Immunity lasts for two to three weeks only, a time long enough to protect a person who has been a contact with diphtheria patient.

(iii) *By Antibacterial Serum*:—Not of any prophylactic value.

PREVENTION AND CONTROL OF INDIVIDUAL INFECTIONS.

CHOLERA

Incubation period is 12 hours to 3 days.

Source of Infection:—Ingestion of infected water (pollution of surface water by faeces by mind cases or carriers defaecating on banks and by washing of infected clothes) (ii) green vegetables, raw fruits contaminated by faeces or polluted by infected water. (iii) milk when diluted with infected water. (iv) mineral waters and Ice when prepared from unpurified water. (v) Flies infecting the food. (vi) carriers—cooks and waiters who handle food. "You can eat cholera, drink cholera but can not catch cholera".

Prevention:—Actions to be taken on occurrence of the disease.

(a) *Isolation of the Sick*:—The sick must be admitted in hospital for strict isolation in a special fly proof infections ward. If possible a cholera ward should have three sections. One for diagnosed cases, another for suspected cases pending diagnosis and the third one for convalescent cases pending negative cholera stools for three consecutive days. Special measures to be taken in hospital for disinfecting vomit, stools and linen. Flies to be excluded rigidly from the ward and latrine. All attendants who come in contact with cholera case are to be inoculated preferably one week before coming on to

duty. No food or drink of any kind is to be taken within the premises.

(b) *Notification*:—To be given to health authorities who should arrange for establishing cholera centre in the villages for disinfection of water supply prophylactic inoculation and also organise a plan of action by survey, spot maps, etc. prepared on the basis of statistics collected from the hospital and burning ghat records.

(c) *Disinfection*:—of vomits and stools by 5 per cent cresol or 30 per cent chloride of lime, mixing and allowing to stand for 2 hours; or freshly prepared milk of lime (1 in 4) or 10 per cent formalin solution mixed with equal quantity of excreta. Rooms to be disinfected (Floor and walls) by formalin, bleaching powder or lime. If it is a mud floor it is to be scraped away, mixed with lime and finally burnt with cow dung cakes.

(d) *Contacts*:—To be kept under surveillance for 5 days.

(e) *Personal Prophylaxis*:—By inoculation once every year, all water and milk must be taken boiled; uncooked vegetables and fruits are better avoided. No cut fruit or food kept over-night should be eaten. Drinking and washing should preferably be done by boiled water. All foods to be protected from flies. Tanks, Ponds, wells to be chlorinated or purified by potassium permanganate. Tanks after disinfection and sterilisation should be kept strictly reserved for drinking purpose only.

(f) *Immunisation*:—Mass inocculation by 1.c.c. of Cholera Vaccine.

(g) *Publicity and Propaganda*:—Anti-cholera propaganda and publicity in the shape of educating the lay public by imparting basic knowledge about principles of cholera infection, manner of spread of the disease; method of prevention; value of preventing water supplies from pollution etc., by posters, cinema slides, lectures etc.

DIPHTHERIA

Incubation period:— 1 to 3 days.

Mode of infection:—By droplet, direct or indirect contact, carrier is the most important source of infection.

Prevention:—Actions to be taken on occurrence of the disease.

(a) *Recognition and Isolation of the sick*:—Early recognition of the disease for successful treatment and prevention is essential. Daily inspection of the contacts during an outbreak would help in detecting cases early. Isolation of the sick preferably in an infectious disease hospital for curative treat-

ment. No convalescent to be discharged till three successive throat swabs are negative.

(b) *Detection of Carriers*:—Carriers are to be detected by means of swab culture and treated by local applications of gargles, paints. Penicillin lozenges antibiotics, tonsillectomy. Serum and vaccines.

(c) *Discovery of susceptible individuals*:—This is done by Schick test particularly in children of school going age and general contacts.

(d) *Active Immunisation*:—To be done to all susceptible persons i.e. Schick positive cases. (See under Immunobiological methods).

(e) *Disinfection*:—Consists of burning of the bed, body linen and other valueless fabrics wherever possible, boiling and steaming of spoon, cups, toys etc. Soaking of bedpans etc. in 2.5% phenol, scrubbing of walls and floors and spraying with standard germicidal solution e.g. Bleaching powder, cresol etc.

(f) *Publicity and Propaganda*:—Should try to educate the public as regards sanitary habits, pessonal hygiene—Eg. spitting in public, sneezing in streets, buses, cinema etc. Basic idea as to the mode of spread and preventon should also be imparted by lantern lectures, Film Shows etc.

MALARIA

Incubation period:—In B.T.—14 days. In M.T.—8-12 days In Q.T.—20-24 days.

Prevention and control of Malaria:—The successful suppression of malaria requires a combined attack upon mosquito and the parasite in human host. But the ultimate success depends mainly upon destruction of the mosquito which is mainly an engineering problem and partly a socio-economic problem. Immediate relief can however quickly be obtained by measures directed against infection in Man.

Before embarking on a control programme in any area Malaria Survey is essential.

Malaria Survey:—The purpose of malaria Survey is to provide following informations and data. (i) Intensity of malaria, (ii) distribution of malaria; (iii) period of transmission (malaria season), (v) Identity of mosquito vector, (v) Habits of Vectors with regard to selection of breeding places, adult resting places etc.

The Survey is done by undertaking investigations along the following lines.

(i) Control and Survey maps just after the rainy season when collections of water become breeding grounds, showing

breeding places classified as potential, actual, temporary or permanent.

(ii) Study of intensity of malaria on local population by—(a) *Spleen Rate (Index)*—It is the percentage of children between the ages of 2-10 yrs who as a result of malaria have a spleen sufficiently enlarged to be capable of detection by palpation. In India the different areas are classified according to spleen rate as follows:—Healthy areas below 10%; Areas of moderate endemicity from 10-25% Areas of high endemicity between 25 to 50% and finally areas of hyper endemicity—constantly 50% or over.

(b) *Parasite Rate (Index)*—It is the percentage of children between the age of 7-10 yrs in whose blood parasites are present.

(iii) *Study of Statistical data*:—These are records of past surveys; hospital admissions and outdoor attendances; morbidity and mortality rates; meteriological records etc.

(iv) *Study of mosquito population*:—(Bionomics) by collection and identification of larvae and of adults; sporozoite index by the percentage of sporozoites in the salivary glands; study of breeding habits, preferential feeding habits etc.

After having finished the malaria survey we can now embark on controlling the malaria.

Malaria Control:—To control malaria our line of attack would be to put a check to the factors essenetially responsible for transmission of malaria. These factors are—Malaria parasite; mosquite vector; Man and the links between mosquito and man.. Thus anti-malaria measures should consist of:—

(a) *Anti parasitic measures*:—(Drug prophylaxis) It can be applied to an individual or a community. Individuals should be given 6 grains of quinine 2-6 times a week; Mepacrine 0.2 gm. twice a week; Paludrine 0.3 gm once a week or 0.1 gm. twice a week. Infected persons showing gametocyte in blood can be rendered harmless by 0.1 gm. of plasmoquine twice daily for 3 days. All these drugs are of clinical prophyactic value and not causal prophylaxis. Drug prophylaxis is expensive both in cost and labour, and is undertaken when no other methods of prophylaxis are available.

"Supressive treatment." (Blanket treatment):—This is done with a view to reduce the occurence of clinical attacks of malaria. This is done before entry into a malaria area or during transmission season and is to be employed under special circumstances. It does not prevent infection. This consists of administration of 2 tabs of mepacrine daily after meal, thereafter 1 tab (0.1 gm.) daily. The persons should be under medical supervision and the treatment is to be continued for

28 days after withdrawal to a non-malaria locality or termination of the transmission season. Paludrine 0.3 gm tab once a week, camqouine 0.2 gm. 2 tabs fortnightly.

(b) *Antimosquito measures*:—These are directed against larvae and adults.

(i) *Measures against larvae*:—These are: Eradication of breeding places by clearing up the jungle, destruction of water hyacinth, establishing drinage to eliminate unnecessary collections of water; avoidance of construction of man-made breeding places, viz., burrow pits on railway lines, railway embankments; Road without culverts and drainage; establishing irrigation with proper drainage. These measures are neither always possible nor practicable.

Larvaecides—(i) *Oil*:—It is lethal to larvae and pupae of anopheline and culicine mosquito. The oil is sprayed on the surface of water with a knapsack sprayer or garden syringe or by soaking lumps of tow or cotton waste in oil and throwing them in water after clearing of vegetations and canalisation of the stream. Each breeding place to be treated once a week with oil; Malariol, crude oil 2 parts and Kerosine 1 part with 1% castor or coconut oil to increase the spreading capacity of the oil are commonly used.

(ii) *Paris green*:—(Copper aceto-arsenite)—It kills anopheline larvae only and has no effect on pupae of anopheline or larvae and pupae of culicine. One part of Paris green is mixed with 100 parts of ash, saw dust, soap stone, or finely screened road dust and then thrown into the air windward side of the pond. It can also be applied by a blower. Surface tension holds the particles on the surface of water, Larvae eats the paris green which acts as a food poison and are destroyed. Culicines are not destroyed as they are not surface feeders. The advantage of paris green are—low cost and portability; high toxicity for anopheline larvae; ease of distribution by wind, can be used in ornamental waters, and waters for domestic purposes as it is devoid of any ill effect, absence of need to remove vegetation so can be used in breeding places full of vegetation.

(iii) *Pyrethrum extract*:—This is particularly effective in shallow waters in which all larvae and pupae of anopheline and culicine are killed instantaneously.

It is applied by spraying the water surface with pyrethrum solution (19 Parts of kerosine and one part of pyrethrum extract).

(iv) D.D.T. (Dichloro-Diphenyl-Trichlorethane). It is the most efficient insecticide with lethal action on larvae and is used as 5-10% oily solution by spray.

(v) *Coal tar derivatives*:—Cylin (drachm to a gallon) kills larvae in few minutes and pupae in half an hour. Cresol 1 in 10,000 solution is specially useful in gravel seepages, sullage, water drains; grease traps and soakage pits but unsuitable for use in ponds used for domestic or drinking purposes.

(ii) *Destruction of adult mosquitos*:—Spray killing with insecticides is the standard method as by D.D.T. and pyrethrum. Freon Bombs are now-a-days increasingly used. These are small hand greenade like containers containing 4% pyrethrins; 8%of sesame oil in 2% Freon gas (dichlor-difluromethane) under pressure which when released leaves the pyrethrum and oil in fine aerial suspension. 5% D.D.T. with 0.2% pyrethrum can also be used as a bomb. A Bomb combines all the advantages of spray including residual action and gives about 100% kill

N.B. *Residual action of D.D.T.*:—D.D.T. used as coarse spray if projected on to the surface to be treated e.g. walls, vegetations etc., the active principle remains after evaporation and acts as a residual contact insecticide.

(c) *Measures in Man*:—Mainly directed against mosquito bites to reduce the chance of contact between man and mosquito vector. These are general protective measures by construction of model town or village settlements under expert advice and supervision, screening of houses, barracks etc. Personal methods of protection against mosquito bites include use of mosquito nets (25|26 Mesh), use of protective clothes, and repellants in the form of a cream containing oil of citronella and pyrethrum extract in a stearic acid base. Dimethyl pthalate, a liquid remains effective for a period of 3-4 hours.

N.B. Mesh of a mosquito net is the sum of the number of holes counted along both lines within an area of one inch square.

(d) *Connecting link between man and mosquito*:—The above measures described under (c) also attempts to sever the connecting link between man and msoquito.

(e) *Publicity and propaganda*:—To educate lay public with lantern lectures, film shows, pictures posters etc., about the cause, spread of malaria, its prevention etc.

Factors necessary for the occurrence and spread of malaria in a community: These are:—

(i) Reservoir of infection—presence of large number of persons with gametocytes in their blood. Young children form the main reservoir in a community.

(ii) Mosquito factor:—presence of carrier sepcies of anopheline mosquito with opportunity to bite repeatedly.

(iii) Meteriological conditions:—favourable for the devolopment of sexual phase of parasite in the vector and the vector to live long to complete the cycle and retain infection. (Can retain infection as long as 2 months under favourable circumstances). These are temperature below 61°F, humidity below 63% are unfavourable. Altitude of 4-6000 ft and moderate and unevenly distributed rainfall are also unfavourable.

(iii) Presence of susceptible human population to which infection may be transmitted. New comers are more susceptible than habitual residents.

(iv) economic conditions.

(v) Irrigation system.

Man-made Malaria:—Obstruction to the flow of natural embankments and roads without culverts which are thus transformed into breeding grounds of mosquito and consequent spread of malaria (often termed as man-made malaria).

PLAGUE

Incubation period:—3-10 days.

Prevention and Control:—Is carried under following heads.

(a) *Isolation and Treatment of the Sick*:—Preferably in an infectious disease hospital. Attendants should be inoculated and use protective clothing like mask, apron, gloves.

(b) *Care of the Contacts*:—The contacts should be kept under quarantine for 10 days with daily inspection.

(c) *Notification*:—to Health authorities for enforcement of antiplague measures.

(d) *Disinfection*:—Of the Room and its contents after removal of the patient by fumigation.

(e) *Measures against Rat*:—(De Ratization)—under two heads. (i) Reduction of Rat population by proper disposal of Refuse, garbage etc., by constructing rat proof granaries. Rat proof sewers etc. (ii) Destruction of Rats:—(a) *Rat traps* 30 per cent of the population should be provided with rat traps.

(b) *Rat poison*:—(i) Barium carbonate 3 grs. per rat. (ii) Zinc phosphide 5 per cent followed by 15 per cent arsenic in baits.

(c) *Fumigation*:—Of Rat holes by cyanogen containing calcium cyanide 45% and slaked lime 55%. Potassium cyanide 45% and slaked lime 55%. Potassium cyanide 5 oz. sulphuric acid 7½ ounces and aqua 10 ounces can also be used for 100 cft. "Cyamag" (Imperial Chemical Industries) contain 20% hydro-

cyanic acid and liberates gas very slowly. Sulphur dioxide 3 lbs. for 1000 cft. can be used by Clayttons apparatus.

(f) *Prevention of Rat Migration*:--Done by preventing shore rats boarding at infected ports and ship rats going ashore in uninfected ports by mooring ships 4 feet away from the quay; using rat guards which are metal discs three feet in diamater placed at right angles to hawsers, and by frequent tarring of the gangway and keeping it off at night. Rat traps can also be provided in the ships.

(g) *Measures against fleas*:—The killed rats are to be burnt with kerosine soaked cloth or by plunging into strong phenol. D.D.T. spraying of the room where the rat was seen.

(h) *Protection of Man from Rat Flea*:—By rat proof house with adequate ventilation, protection of drains by iron grating. Plague workers should use gum boots, apron, masks, gloves etc.

(i) *Prophylactic inoculation*:—Haffkins vaccine ½ c.c. followed by 1 c.c. within 7-10 days. Formolised casein hydrolysate (Sokhey's) 1 c.c. followed by 1 c.c. within 7-10 days. During epidemics 2 c.c. as a single dose.

(j) *Publicity and Propaganda*:—By educating the public about the spread of the disease and methods of prevention.

N.B.—"Rat fall":—It is a warning signal of a threatened epidemic indicated by dead rats usually falling from the roof.

RABIES

Incubation period:—10 to 90 days according to the location of the bite and extent of the wound. The wound nearer to the head and face have shortest incubation period (10-15 days). It may in the other extreme be six months or even more. Incubation period in dogs varies from 14 to 16 days.

Symptoms of Rabies in dogs:—Rabies in dogs occurs in 2 forms.

(i) Furious Rabies, (ii) Paralytic Rabies.

After a stage of development for 1-2 days the stage of excitement follows—the animal first becomes unusually depressed or affectionate, may show irritability or snappishness, then the dog develops an irresistible desire to roam or to bite anything (during excitement stage) that comes in its way, utters a shrill meaningless bark. There may be drooping of lower jaw with foaming due to dribbling of saliva. Later on seeks a secluded corner and attacks anybody who comes near, still later voice is lost, the animal mews hoarsely. Finally comes the stage of Paralysis when the animal develop paralysis and dies within 6-10 days.

How to send the head of an animal suspected of having died of Rabies?:—The unmutilated head of the animal is cut off, packed in abundance of ice and sent to the laboratory.

Prevention and control:—is done under following heads.

(a) *Control of Rabies in animals*:—By legilation and rigid enforcement of laws.—Eg. licensing of all dogs; destruction all stray unlicensed dogs; six months quarantine for imported dogs and the muzzling of all dogs during a rabies epizootic.

(b) *Control of infection in man*:—Wound to be cleaned and immediately cauterised with pure phenol or fuming nitric acid. Antirabic vaccination should be carried out as early as possible.

(c) *Rabid animal*:—To be caught if possible and shut up for observation. If it dies within 10 days or shows signs of rabies it is to be killed and head sent for examination of the brain. If the animal survives 10 days it can be assumed that the dog was not rabid.

N.B.—Anti Rabic Vaccine may be both dead and alive. Phenolised sheep vaccine made up as 1% emulsion of sheep's brain is best.

TUBERCULOSIS

Mode of infection:—(1) ingestion of tuberculous milk. (2) by inhalation of tuberculosis sputum by inspiring finely divided droplets carrying the bacillus.

Source of infection:—Tuberculous milk and pthisical sputum.

Prevention and control:—As the spread of infection in tuberculosis is by consumption of tuberculous milk and contact with human cases of pthisis our first aim should be to prevent infection.

(a) *Prevention of infection*:—(1) From bovine source by preventing the consumption of infected milk which can be done by (1) destruction of every tuberculosis positive cow and building up a tuberculosis neegative herd. (as in Denmark). (2) By slaughtering of clinically tuberculous cow with compensation to the owner (as tried in Egnland). (3) Encouraging and providing the sale of milk known to have been obtained from tuberculous negative cow or prepared under conditions that exclude the presence of tubercle bacilli (Pasteurised milk). But none of the above methods are practicable on a large scale.

(2) *From human source*:—By preventing contact with human case of tuberculosis either at home or outside. This can only be done by medical organisation which would ensure early possibility of diagnosis ; treatment, after care etc.

The medical organisation should consist of chest clinics which should form and remain the pivot of all anti-tuberculosis activities. These centres should arrange for early diagnosis by mass radiography; regular tuberculin testing in schools with X Ray of positive reactors and subsequent check up of adult contacts in conjunction with school medical service. The chest centre should also arrange for health visitors to visit homes, educate and teach hygeinic principles to home patients. Besides the clinic should arrange for B.C.G. immunisation of those cases who invariably come in contact with infection, e.g. nurse, medical students, and certain home contacts of sputum positive cases.

(b) *Isolation and treatment of the sick*:—to be done by establishing tuberculosis hospitals, residential institutions and sanatoria who would function as receiving centre for diagnosis and curative treatment, as centre for observation and clearing up and supervision of domicillary cases.

(c) *Establishment of after care colony*:—Residential institutions besides hospitals and sanatoria should include village settlement (T.B. colony) with measures for diversional and occupational therapy, suitably employing ex-tuberculosis patients to enable them to take part again in social and economic life of a community.

(d) *Publicity and propaganda*:—Every possible approach to public—Radio, film, press; posters should be utilised for propaganda amongst the masses to lay stress on danger of infection and how to avoid it?; the value of mass examination, prophylactic immunisation and assurance of good chance of cure for cases diagnosed early.

Finally improvement of general living and working conditions must be left to public conscience and future social development. The importance of nutrition cannot be overemphasised. But this can be said that early diagnosis brings about effective treatment of potentially infections cases. Search amongst contacts would lead to detection of source cases Social adjustments speed the patient's own recovery and present his future breakdown, besides protecting his dependents and others while efficient therapy practised on a large scale steadily reduces hard core of persistent infection in a community.

Establishment of facilities by the state for social assistance to support the patient and his active dependants during the

period of his active illness is vitally necesasry. Non-existence of this facility would militate against the effectiveness of other controls. A scheme which would have the possibility of being introduced within a period of a few years and which is within the financial means of the country, has been drawn up by a specially constituted committee of the Planning Commission. In this, emphasis was laid on what were considered immediately possible, specially those pertaining to prevention of the disease.

(1) *B.C.G. Vaccination*:—This is given top priority for two main reasons:

(a) Preventive measures are cheaper and more effective in the long run than curative measures.

(b) It is a method which can be cheaply and quickly applied.

In some countries in the West which have achieved a large measure of tuberculosis control, extensive B.C.G. vaccination may not have any place as a major tuberculosis control measure. In India and other countries similarly placed, BCG vaccination seems to be the method of choice for a rapid means of stemming and controlling the increase of tuberculosis. It was introduced into India in 1948 and extended on a large scale in 1951. Upto the end of April this year 7,833,000 persons have been tested and 2,488,000 have been vaccinated. A sum of about 19½ lakh rupees is being spent annually for this by the State Governments in India. The Government of India is providing the supervisory and co-ordinating staff. A Central laboratory in India prepares and distributes the vaccine. At present 80 Indian teams (91 doctors and 246 technicians) are working on the BCG programme. WHO and UNICEE are co-operating both with regard to personnel and the equipment.

(2) *Tuberculosis Institution*:—It is fully understood that much more institutions of a simple design cheaply constructed are needed. The climate in India is such that this can be done. It is necessary to emphasise, that it is the responsibility of municipalities to provide such hospitals for the use of their inhabitants.

Special agencies employing large number of people are, to be encouraged to provide facilities for treatment of their own tuberculous patients; these agencies are railways, posts and telegraphs department of Government, and large industries either owned by Governments or private bodies. It is gratifying to note that the Railway and Post and Telegraph Departments of the Government are actively considering the provision of facilities for treatment of tuberculous patients among their employees.

(3) *Training Centres*:—The plan includes the establishment of a number of training centres. Six centres are already engaged in post-graduate teaching in tuberculosis. To these have recently been added three more centres with the assistance of WHO and UNICEF extending the scope of training to technicians and anciliary personnel needed for a tuberculosis programme; seven more are planned for the immediate or near future. The reason why priority is given to these centres is the need for trained personnel for staffling tuberculosis services. There will also be centres for instruction of medical students and for refresher courses for general practioners.

(4) *After-Care*:—The need for after-care colonies and rehabilitation centres is fully recognised but it is realised that these cannot be developed on a large scale at present. Even in wealthier countries the provision for after-care has proved inadequate and the development in this respect has been slow. It is, however, suggested that attempts be made to stimulate voluntary organisations to set up with State aid, after-care colonies or work centres at suitable places in association with tuberculosis institutions.

(5) *Research*:—There is a vast field for research particularly with regard to specific problems connected with tuberculosis peculiar to India, and also for research into some problems for which opportunities may not be avaliable in some of the countries where tuberculosis has already been controlled. Certain factors in connection with BCG vaccination such as variations noted in tuberculin reactions in the different groups and areas are under enquiry. At the same time general epidemiological problems relating to infection and the spread of tuberculosis in Indian environment are a subject of careful observation and study, often using miniature mass X-ray by a number of investigators.

Domiciliary (Home treatment) of T.B. patients at their homes through mobile units is also being contemplated.

The T.B. Association has recently started the Tuberculosis Seal Sale Campaign in this country. This will be an anual feature. The amount of money that can be realised by this campaign will depend upon the co-operation, the community can give. The funds collected by this campaign will be used in different parts of the country for anti-tuberculosis work. More than the fund raising is the educative value which the propaganda associated with it carries to the masses.

It is also very heartening to note that tuberculosis is being now recognised as a world problem and attempts are being made to deal with it in this light by international bodies viz., the world Health Organisation and the United Nations International Children's Emergency Fund. Let us therefore

hope that with the united efforts of all, especially the people of this country, a seemingly impossible task of controlling tuberculosis in this vast country, can be achieved earlier than what would be possible by isolated efforts.

N.B.:—The Government have opened a 600-bed hospital at Kanchrapara and a 200-bed hospital at Digri, Midnapore district, for the isolation and treatment of tuberculosis cases. Each district hospital has, in any case, from four to twenty beds for advanced tuberculosis cases. There are 11 chest clincs for the early detection and treatment of patients in the mofussil. Nearly three million people have been tested in the B.C.G vaccination campaign and 900,000 people have been protected with preventive inoculation. Young people below the age of 20 are selected for this vaccination. All the towns of the districts have been visited by B.C.G. teams and they are now working in the villages to cover as large an area as possible.

TYPHUS FEVERS

Classification:—

(1) Epidemic Typhus: (Louse borne).	Incubation period:—10 to 14 days. Virus:—Rickettsia Prowazeki. Vector:—Human lice (Pediculus humanus). Reservoir of infection—man. Dissemination by migration of infected lice by contact, contamination with infected faeces of lice, airborne infection from dried faeces of lice.
(2) Endemic or Murine-typhus:	Incubation period—10—16 days. Virus:—R. Muricola or R. Mooseri. Vector:—Xenopsylla cheopis and poly pax spinulosus. Reservoir:—Rat and mice.
(3) Tick Typhus: (Rockey Mountain Spotted fever).	Incubation period—3—12 days. Virus—R. Rickettsi (Dermacentoroxemus —Rickettsi). Victor:—Wood tick (Dermocentor Andersoni). Vector:—Dog tick (Dermocentor Variabilis). Reservoir—not known.
(4) Mite or Scrub Typhus: (Tsut Sugamushi fever).	Incubation period—5—21 days. Virus:—R. orientalis. Vector:—Trombicula akamushi. Reservoir:—Rat and mice.
(5) Trench Fever: (Weigl's disease).	Incubation period:—8—10 days Virus:—R. Quintana (R. Weigl). Vector—human lice. Reservoir of Infection—lice.
(6) Q. Fever.	Virus—R. brunetti. Vector—tick. Reservoir—bandicoot.

What are Rickettsia?:—These are granule like bodies (½ to 1 micron) placed between filterable virus and bacteria in behaviour. These do not grow in ordinary media but can be grown in tissue culture media or on yolk sac of developing chick embryo. These do not stain by aniline dyes but stains well by geimsa stain. These are doubtfully filterable.

Prevention and control (of Epidemic Typhus):—It can be summed up in one word 'No Lice, no Typhus.'

(a) *Isolation and treatment of the sick*:—In hospitals. Before admission into the ward the patient should be undressed in a special room, the floor of which is covered by two sheets one on top of another. The patients clothing and any lice which may drop off should be immediately wrapped in Ist sheet and removed for disinfection. After undressing patient's whole body should be covered with soft soap or ointment to smother lice and prevent dissemination of lice excreta. The hair of the head is clipped, and the hair clippings are removed in 2nd sheet and burnt. Attendants should wear protective clothings.

(b) *Notification*:—to health authorities for necessary action.

(c) *Care of contacts*:—All contacts should be properly cleaned, clothings disinfected, and segregated for 14 days under daily inspection.

(d) *Immunisation*:—By antityphus vaccine, (Weigl's; Zinsser; and Durand and Sparrow's—see under immunity). Protection of wholesale population by this method has not yet been universally adopted.

(e) *Disinfestation*:—stretchers, blanket, clothing, equipments etc., all to be disinfested. These are immediately immersed in 2½% cresol. wrung out, wrapped in a sheet, carried to the disinfector and immediately disinfected.

(f) *De-lousing*:—The different methods of delousing are— (a) *Heat-Dry heat*:—Lice and their nits are killed by exposure to a temperature of 20°C or over for one minute. Hot air disinfector (Millbanks) or hot air huts and boxes (Orr's hut) serve the purposes well.

(1) *Moist heat*:—It is quicker and surer in action due to greater penetrating property.

(2) *Chemicals*:—D.D.T. (10%) in the form of a powder ground up in China clay or calcium carbonate (freshly prepared). Impregnation of clothing is an effective way to con-

trol lice, effect remains for 2-3 weeks if clothing are not washed. D.D.T. can also be used in the form of 20% emulsion. Other chemicals used are: N.C.I. powder consisting of napthalene 96%, creosote 2% and lodoform 2 p.c. 2 p.c. Lysol or cresol for one hour at any temp. above 50 Deg. F. can be tried. Lorexane lotion is a good lice killer.

(3) *Fumigation*:—Can be tried but formaldelyde and sulphur dioxide do not kill nits. Hydro cyanic acid gas in the proportion of 10 ounces of sodium cyanide per 100 cft. is sufficient to kill adult lice and prevents eggs hatching when clothes are freely exposed to fumes for two hours.

N.B.:—Prevention and control of endemic typhus are carried on same lines except that here measures are directed against control of rats and rat fleas.

VENEREAL DISEASES

Venereal diseases include syphilis, gonorrhoea, soft sore, lymphopathia venereum and granuloma venereum.

PREVENTION AND CONTROL

(a) *Publicity and Propaganda*:—By lectures, cinematographs, posters advising the adults to lead clean healthy lives—to be continent and not to indulge in illicit sexual intercourse as it is morally wrong to do so; the strong risk of contacting V. D. by such acts, its future aftermath over him, his wife and unborn children or to his family. Besides there should exist amneties to sublimate sex by offering innocent pleasures and amusements.

(b) *Establishment of V.D. centres and clinics*:—For expert diagnosis and curative treatment with a view to render the patients noninfective as early as possible.—To gain popularity and confidence these centres should ensure that all informations concering persons treated should be regarded as confidential. It is also very important that every case of suspected or actual V.D. should be diagnosed and treated confidentially free of cost.

The clinics should better be held at hours likely to suit the convenience of the patients and endeavour to be made to secure all possible privacy. In addition to separate female centre attached to a V.D. clinic seperate clinics should be attached to maternity and child welfare centres for the same purpose.

Preventive clinics and ablution rooms can only be advocated under special circumstances (during a war for the soldiers) by providing them with preventive packets and arrangements for cleaning, washing, irrigation etc.

(c) *State administrative measures*:—These are suppression of prostitution by legislation, periodical inspection of the prostitutes, treatment of the infected ones. But it must be said that recognised and registered prostitutes are not the only source of infection hence other measures of control as outlined above are to be adopted.

YELLOW FEVER

Distribution:—Yellow fever is confined to some parts of South and Central America and Africa up to Anglo Egyptian Sudan, Uganda and Tanganyika.

Transmission:—Caused by a filter passing virus communicated by the bite of Aedes Ageypti mosquito. The mosquito gets infected during first 3 days of fever but once infected remains so for the rest of its life.

Prevention:—(a) *prophylactic inoculation*:—by yellow fever vaccine of all persons at least 10 days before going to a yellow fever area .05 c.c. (1500 mouse protection units) of vaccine would produce an immunity which is protective from 10th day to 2 years.

(b) *Anti-mosquito measures*:—to control aedes mosquito by eliminating breeding grounds, antilarval meeasures, destruction of adult mosquito and individual protective measures against the bite of mosquito.

(c) *Special measures*:—Air traffic increased the danger of bringing infected persons from yellow fever area to India. The planes coming from yellow fever area while passing through Khartoom or Cairo are subjected to anti-yellow fever measures and disinsectization of the aeroplanes before they leave. The aircraft is provided with a disinsectization certificate. But if the aircraft arrives without it, it will be disinsectized on arrival in India and all persons on board except those who are inoculated will be subjected to isolation for nine days (six days for incubation plus three days more).

Lastly no one who has been to a yellow fever area may enter India unless such person has had the disease, or has been inoculated not less than 10 days ago and not more than two years before entering a yellow fever area and nine days have elapsed between the date of leaving yellow fever area and arrival in India. Failing above he will be subjected to a quarantine for the balance period.

Notifiable diseases:—It means outbreak of a case of infectious disease which is to be immediately intimated to health

authorities for preventive measures. These are small pox; cholera, plague diphtheria, typhoid, influenza, C. S. fever or any other infectious disease which local authorities have made notifiable.

Epidemic:—Sudden outbreak of cases by infection from a common source at a time followed by a period of rest.

Endemic:—When a particular disease is constantly present in a locality through out the year.

Sporadic:—When an isolated case occurs in a locality.

Epizootic:—Epidemic in animals.

Vector:—The insects which act as intermediary in spread of any infection is known as a vector.

Fomites:—These are inanimate objects like clothings, utensils etc. which are capable of retaining and transferring an infection.

Carrier:—is an apparently healthy individual who harbours pathogenic organism and form an important source of infection. Carriers are therefore a potential and real danger to the community. Carrier state may succeed a definite attack of illness (active carrier) or may develop in an apparently healthy individual who himself never suffers from the disease but harbours the infection. (passive carrier).

Qurantine:—This is a System of detention of all persons exposed to infection for at least the longest incubation period of the disease with a view to put a check to the spread of communicable diseases.

Varieties:—(1) International quarantine—detention of all persons coming from an infected area, (ii) domestic quarantine—when isolation is done at one's own house as in a case of chicken pox.

Incubation and segregation periods:

Diseases	Incubation period	period of infectivity or quarantine
Chicken Pox ..	12—14 days	3 weeks.
Cholera ..	1— 5 „	2 „
Dengue ..	3— 6 „	2 „
Diphtheria ..	3— 6 „	2 „
Enteric fever ..	12—14 „	6 „
Influenza ..	1— 4 „	2 „
Measles ..	8—15 „	3 „
Mumps ..	10—20 „	3 „
Plague ..	3—10 „	3 „
Small Pox ..	3—12 „	6 „
Whooping Cough ..	7—14 „	8 „

CHAPTER EIGHT

INSECTS AND PARASITES

Insects are a group of arthropods who have symmetrical bodies, jointed appendages with heart at the back and nervous system in front.

Classification:—Insects are classified under two groups.

(A) Wingless insects
- (i) Fleas.
- (ii) Lice.
- (iii) Bed bugs.
- (iv) Ticks.

(B) Winged insects
- (i) Mosquito.
- (ii) Sand fly.
- House fly.
- Tsetse by.

FLEAS.

These are wingless insects 2-3 mm. long with laterally flattened bodies.

Life history:—Eggs are laid singly (8-12) in the hairs of the host animal but soon falls to the ground. Eggs hatch out into larvae in 2-4 days in summer and 2 weeks in winter. Larvae thrives on organic matter. Larvae develop into pupa in another 2 weeks time by spinning a cocoon in which it pupates. Pupa develops into an adult flea in another 2 weeks time. Time taken from egg to adult—18 days to 3 weeks. Fleas can jump 3 to 5 inches and never more than six inches but can crawl up to 8 inches.

Varieties:—Xenopsylla cheopis and astia (Rat flea)

Xenopsylla ceratophyllus fasciatus, (Rat flea of Europe).

C. teno cephallus canis and Felis (Dog and cat flea).

X. ceratophyllus acutus—Squirrel flea.

— C. Tenopthalmus agyrtes—Mice flea.

Flea borne diseases:—(i) plague, (ii) endemic typhus.

Mode of Infection in plague:—The flea ingests blood of an infected rat, the plague bacilli multiply in its midgut (Proven-

triculus) and the bacillary mass eventually extends into oesophagus blocking the entrance of stomach. The flea makes violent efforts to make another blood feed, as a result of which oesophageal contents regurgitate and the bacilli are thus injected via the proboscis into the new host. Infection may also occur from bacillus containing faeces of the flea voided on the skin and rubbed into the wound. Rat fleas have been known to remain infective for 6-7 weeks.

Destruction of flea:—(i) Spraying of 5-10% D.D.T. Solution in Kerosine (2 quarts per 1000 cft). It is very effective if applied to floor, lower three feet of the wall and the furniture. A powder containing 10% D.D.T. can be used for clothing. Gamaxine is also a very useful killer.

(ii) Pesterene mixture consisting of Kerosine 20 parts, soft soap, one part and water 5 parts.

(iii) A mixture containing cresol 5 parts, soft soap 20 parts and water 75 parts.

iv) Formaldehyde solution 5%.

(v) Fumigation by hydro cyanic acid and Sulphur dioxide gas.

RATS:—are of two types—(i) *Rattus Rattus* (*Black Rat*) —These are small in size, black in colour with tail never shorter than head and body combined. The length of hind feet from heel to toe seldom if ever is longer than 40 mm. Ears are translucent and when drawn covers half of the eyes.

(ii) *Rattus Norvegicus*:—(Brown Rat). These are of large size and hairy. Tail is shorter than head and body combined. Hind feet more than 40 mm. Ears are small and thick.

Life history of Rats:—Rats breed only when 2 months old produce 5-6 litters in a year and each litter of 8-10. Gestation period 21 days.

Destruction of Rats:—See under plague.

Rat borne diseases:—(1) Leptospira Ictero haemorrhagica (Well's disease). (ii) Rat bite fever. (iii) Rat Typhoid—cause gastro enteritis in man by soiling of food dishes with excreta of infected animals.

LICE

Varities:—(i) Pediculus capitis (head lice) (ii) Pediculus corporis (body lice), (iii) phthirus pubis (pubic or crablice).

Life history:—Eggs deposited remain glued to the hairs by a substance secreted from female and are provided with a granulated cap (operculum). Eggs hatch in 7-10 days time and undergo three moults to mature. The time taken for Ist and 2nd moult each is 2 days and 3rd one 3 days. Adults deposit 4-5 eggs a day for 4-5 weeks. Complete cycle from egg to egg is 16 days. The average life of a lice is 35-40 days.

Destruction of lice:—(Head). The following are effective (i) D.D.T. antilouse powder consisting 10% D.D.T. ground up in china clay or calcium carbonate freshly prepared. Impregnation of clothing with this powder is an effective way in control of lice (2 ozs perman) applied by a hand dust gun or a sifter. The efect remains for 2-3 weeks if clothings are not washed.

(ii) D.D.T. can also be used as an emulsion (2%).

(iii) 50% lethane in white oil 7-8 c.c. by massaging the scalp with finger.

(iv) methylated spirit (7 parts) in 3 parts of water ½ to one ounce for head.

(v) Kerosine and Vinegar or Kerosine and olive oil in equal parts.

(vi) Phenol 2.5% or Lysol 1% may also be applied.

(vii) Lorexane head lotion.

For Phthirus Pubis:—(i) shaving and cleaning with soap followed by application of perchloride of mercury (1 in 1000) lotion in equal parts of alcohol and water or in water to which a small quantity of Vinegar is added.

(ii) Xylol 20 c.c. in 3 gms. of Vaseline, freshly prepared and applied every other day for 2-3 times is effective.

(iii) Applciation of a solution containing Kerosine oil 74 parts arachis oil 20 parts, tar oil 5 parts and Lemon grass oil 1 part may be tried.

De-lousing:—See under typhus fevers.

Louse borne diseases:—(i) Epidemic typhus; (ii) Relapsing fever, and (iii) Trench fever.

BED BUGS

Varieties:—(i) Cimex lectularis (common bed bug).
(ii) Cimex hemiptera.

Life history:—Eggs are laid in clusters (20-50). Larvae hatch out in 7-10 days. Larvae moult soon after a blood meal if available and attain Ist nymphal condition and reach the adult stage after four subsequent moults. Time taken to reach

adult stage from the eggs is 6-7 weeks. Bed bugs can live up to a year without food.

..Destruction of bed bugs:—(i) boiling (temp of 160°F) kills bug at all stages. (ii) Blow lamps for Iron bed steads. (iii) D.D.T. in Kerosine spray though not lethal to eggs, kills. the young ones by residual effect as the young ones hatchout. D.D.T. in powder form can also be applied in furniture clothing etc. (iv) Fumigation with heavy naptha, sulphur dioxide formaldehyde, hydrocyanic acid etc. (v) Gamexin in powder form.

Bug borne diseases:—None definitely known but has been accused of carrying K. A., Relapsing fever, typhus etc. "It is an efficient experimental host of trypansoma cruzi and Leptospira Icterohaemorrhagica".

TICKS

Life history:—Eggs are deposited in a mass (1000) on the grounds. Larvae hatch out after 2-3 weeks . These attach themselves to the suitable host, feed, drop to the ground, moult and become nymphs. Nymphs climb upon blades of grass, wait to attach again to a host, feeds, drops and moults again to become an adult. Time taken to mature is 1-2 years.

Destruction:—By application of turpentine, Benzene, petrol or parafin applied by a hair brush between skin and the tick.

Tick borne diseases:—Tick Relapsing fever and Rockey mounted spotted fever or Tick typhus.

(B) *WINGED INSECTS. MOSQUITO.*

Mosquitoes are distinguished by the presence of scales on their wings and proboscis.

Varieties:—The Important vectors of India are as follows:

(A) Anopheles.

A. minimus—Vector in U. P. North Bengal and Assam.

A. Fluviatilis—South India, Mysore, Travancore.

A. Culicifacies—Particularly N. W. India.

A. Stephensi—Western and N. W. India.

A. Superpictus—N. W. Frontier Province.

A. Philippinensis—West and Southern Bengal.

A. Sundaicus—Bengal, Orissa, Andamans and Nicober Islands.

A. Annularis—and A. leucosphyrus—Assam

(B) Culex. Aedes Aegypti.

Aedes Variagatus.

Culex fatigans.

Breeding habits:—(i) *A Minimus*— breeds in clear unpolluted slowly moving water with grassy edges as in a stream or irrigation channel. Can also breed in partial shadowy places like wells and cisterns.

(ii) *A. Fluviatalis*:—Same as minimus.

(iii) *A. Culicifacies*:—Breeds in fresh clean water, in irrigation channels, in sluggish streams often with sandy margin and little vegetation, in sheets of fresh rain water, in Rice fields, borrowpits, in shallow wells and pools.

(iv) *A Stephensi*:—Breeds in wells, cisterns, fountains, receptacles. In rural areas it breeds in pools, margin of streams, in seepages and marshy areas; in springs, shallow wells and garden pits conatining seepage water. Can also breed in salt water.

(v) *A. Philippinensis*:—Breeds in tanks, pools, borrowpits and ditches containing clean water with marginal bushes and a dense growth of subaqueous bushes. It does not breed in water even slightly contaminated.

(iv) *A Sundaicus*:—It breeds in saline water usually, like lagoons formed by silting up of river mouths and behind embankments erected to protect rice fields from saline water.

(vii) *A. Super pictus*:—Marked preference for running water exposed to sunlight occurring mostly along edges of streams and rivers. Other breeding places are marshy areas, exposed to sunlight occurring mostly along edges of streams open irrigation channels, reservoirs, wells, springs.

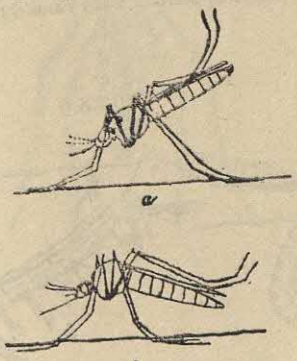
(viii) *A. Varuna*:—breeds in stagnant water in pool, ditches wells, slow running streams and irrigation channels particularly during and immediately after monsoon rains.

(ix) *Aedes Aegypti*:—domestic in habits, breeds in small collection of water, in old tins, broken utensils hollow tree trunks etc. Seldom fly far away from its breeding place.

Distinguishing features:—

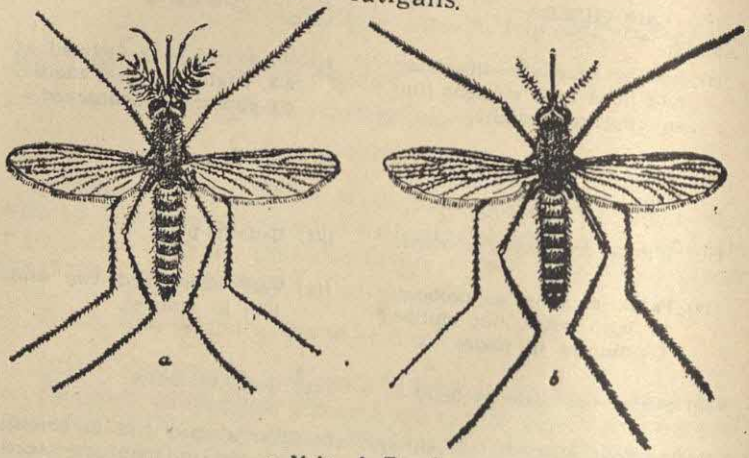
	ANOPHELES.	CULEX.
(a)	Adults:	
	(i) Resting attitude—the body and head in a straight line so appears straight.	(i) Head and body inclined at an angle to one another so appears hunchbacked.
	(ii) Proboscis—in one line with body and head.	(ii) Not in one line.
	(iii) Wings—frequently spotted.	(iii) Usually plain.
	(iv) Palpi—as long as proboscis in both sexes, but clubbed terminally in males.	(iv) Very short and two knob like in females.
	(v) Scales—no scale in belly	(v) Scale in belly.
(b)	Eggs:—Boat shaped, laid singly. 100—200 in number aggregation into clumps occurs giving triangular and star shapes.	(b) Cigar shaped laid in batches, 200—500 in number: Aggregation occurs into rafts of hundreds of eggs.
(c)	Larvae:—Small head, norespiratory siphon or breathing tube. Being surface feeders floats horizontally over the water surface.	(c) Large head, have a long respiratory syphon, hang downwards from water surface suspended by the siphon with their bodies at an angle to the surface of water.
(d)	Pupa:—Breathing trumpets funnel shaped	(d) Breathing trumpets long and narrow.

—Anophelini (*a*) and Culicini (*b*).



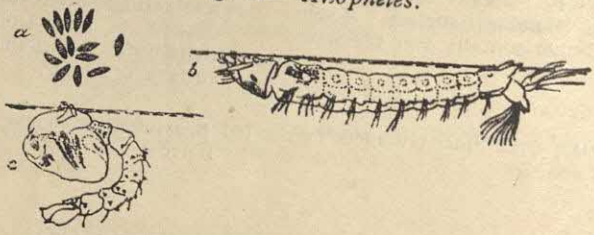
In resting position. Note angles assumed by the bodies of the insects relative to the surface on which they are resting.

Cluex fatigans.



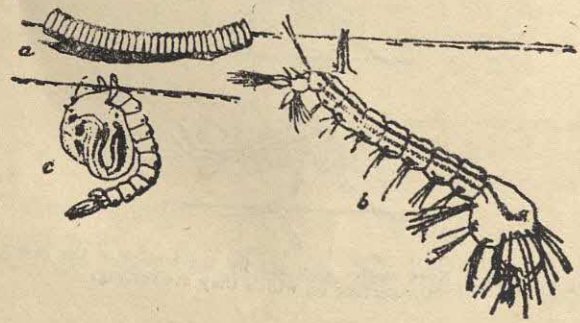
a. Male. *b*. Female.

Fig. 11.—*Anopheles*.

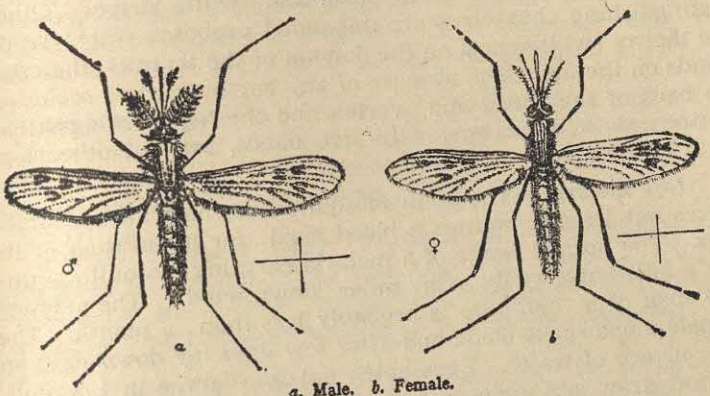


a. Eggs ; *b*. Larva (note resting position, body *parallel* to surface of water) *c*. Pupa

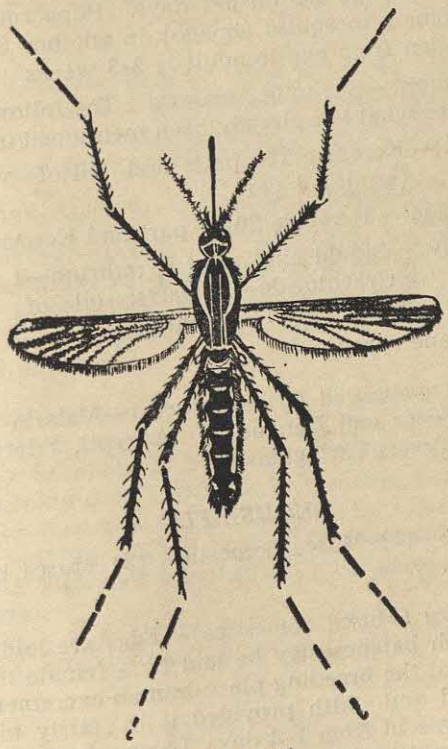
CULEX.



Anopheles



a. Male. *b*. Female.



Aedes Aegypti

Aedes Aegypti:—(characteristics) This mosquito is characteristically marked with black and white stripes. Other distinguishing characters are unbanded proboscis, the lyre on the thorax (white mark on the dorsum of the thorax), the cross bands on the abdomen, absence of any narrow curved scales on the back of the head and vertex and the leg markings-tibae entirely dark, hind tarsi with five bands, tarsi of other legs with two bands.

Life history:—The adult mosquito lives on fruit and plant juices but female requires a blood meal for maturation of its eggs. The normal range of a malaria carrying mosquito is under a mile but may fly many miles "down wind". The average life span of a mosquito is probably less than a month. The female alone sucks blood and after few days lay down eggs on the surface of water. Eggs hatch out into larvae in 1-3 days. Larvae grow and undergo 4 moults. The time spent in larval condition depends upon temperature of water and food supply but both being favourable the condition is passed thruogh in about a week to ten days. The fully grown larva casts its skin and becomes a pupa within 5-7 days. Pupa comes out of its case to become a mosquito (imago) in another 3-5 days time. The time taken from egg to adult is 2-3 weeks

Destruction:—See under malaria. The following are good sprays besides what has already been mentioned under malaria.

(1) Flit:—Kerosine 100 parts and oil of winter green (crude) 1 part.

2. Pyrocide:—Pyrocide 20—1 part and Kerosine 19 part.

3. Pye fly:—Liquid extract of Pyrethrum—1 part; Carbon tertrachloride—2 parts; oil of citranella—4 parts; petrol—11 parts.

4. Lorexane spray.

Disease transmitted by mosquitoes:—Malaria by Anopheles, Yellow Fever and Dengue by Aegypti, Filaria by Culex fatigans and Aedes Variagatas.

HOUSE FLY

Varieties:—(1) Musca domestica, (2) Musca humilis, (3) (4) M. Vicina.

Life history (Musca domestica)—Eggs are laid in batches (120-500-4 such batches may be laid by a female in a season) on the surface of the breeding place-human excrement, manure, scraps of food and filth provided it is fairly moist. Eggs hatch into larvae in from 1-4 days. Larvae feed on decomposing material, grow fully, migrate to comparatively dry earth underneath the surface and develop into pupa in a hard brown

case-puerparium in 3-5 days time. The adult fly then emerges working its way through the soil to the surface in another 3-5 days. After an hour of emergence the wings are fully expanded and little later the fly is capable of flight.

Mode of Infection:—These are nonbiting flies and act as mechanical carriers of infection by conveying pathogenic organisms on its body, wings, legs and faeces. Infection remains 36 hours in legs, 8 days in vomit and 18 days in faeces.

Antifly measures:—(a) *Preventive*—(1) removal and proper disposal of all refuse including horse, cow dung, night soil etc. (2) by storage and protection of food by fly proof covers. (3) education of lay public in anti-fly measures.

(2) *Destructive measures*—(1) Trapping by tangle foot and other fly papers prepared by a mixture of 5 parts by weight of crude castor oil with 8 parts of crude resin. Trapping can also be done by 'box traps' and 'balloon traps'.

(2) Swatting by wire mesh of leather flaps attached to handles.

(3) *Poison baits*:—Bread, blotting paper etc., may be moistened with poison mixture consisting of (a) Formalin—2 table spoon full of formalin, 2 table spoon full of sugar, ½ pint of clear lime and finally adding water up to one pint.

(b) Sodium Arsenite—6 tablets to a pint of water.

(4) Spraying:—D.D.T. and pyrithrins in Kerosine—5% solution or emulsion (2 quarts per 1000 sq. ft.). 1% oil of winter green in 99% light kerosine cause death to fly in half and hour. Gamexine powder and lorevane acrosel spray are both safe and effective.

Antilarval measures:—Spraying of Sodium arsenite on manure and other breeding places. (2) Sprinkling of chloride of lime. (3) Spraying of 5% D.D.T. Solution (8 ozs per 100 cft.) (4) sprinkling of D.D.T. and gamexin powder in dust (6 ozs. of 10% dust per 100 sq. ft.) (5) By close packing the manure and relying on the heat of fermentation to kill the larvae. (112°F kills in 3 minutes). ( ) Trapping the larvae in special gutters..

Diseases Transmitted:—diarrhoea, dysentery, cholera; Typhoid.

SAND FLIES

Varieties:—(1) Phlebotomus papatasi, (2) P. argentipes (3) P. sergenti.

Identification:—By stout body, humped thorax, hairy body and butterfly wings.

Life history:—Egg hatches into larve in 7-10 days time. Larvae live in organic matter, grow into a pupa in 14 days. Pupa becomes an adult fly in another 10-14 days. The whole cycle takes 6-12 weeks.

Antifly measures:—The preventive measures consist of extirpation of breeding places, and use of sand fly net. (45 meshes per sq. inch). Destructive measures are the same as mentioned under house fly.

Diseases transmitted:—Sand fly Fever, oriental sore and probably Kalaazar.

TSETSE FLIES

Varieties:—The Commonest ones are (1) glossina papalis and (2) glossina morsitans.

Life history:—The female fly does not lay egg but gives birth to a single mature larva in a carefully selected spot (light soil with some degree of shade). Immediately after the birth the larva buries itself and pupates in 3-4 weeks time.

Diseases transmitted:—Sleeping sickness (Trypansomiasis)

OTHER MINOR FLIES

1. Stable fly—(Stomoxys calcitrans).
2. Blue bottle fly—(Calliphora).
3. Green bottle fly—(Lucila).
4. Horse and other animal fly—(Hippobosca).

VIRUS DISEASES

1. Neurodermotropic—Small pox, chicken pox, herpes zoster and lymphopathia venerum.
2. Neurotropic:—Rabies and acute anterior poliomyelitis
3. Dermotropic:—Molluscum contagoisum.
4. Respiratory group:—Measles, common cold, Influenza.
5. Viscero tropic:—Yellow fever, dengue, sand-fly fever, typhus, Infective hepatitis, mumps.

SPIROCHAETAL DISEASES

- (1) By Direct Contact ..
  - Syphilis—Trepanema pallida.
  - Yaws—Trepanema pertenue.
  - Vincents Angina—Trepanema Vincentis.
- (2) ByBlood Sucking insects (Blood stream infection)
  - Relapsing Fever—Tr. recurrentis.
  - Tick Relapsing Fever—Tr. duttoni. (South African).
  - Indian Relapsing Fever—Tr. carteri.
- (3) By Rodents .. (Blood stream infection)
  - Weils Disease—Leptospira Icterrohaemorrhagica (by rats and mice).
  - Sevenday Fever—Leptospira hebdomidis (by field mice).
  - Ratbite Fever—Spirallum morsus minus.

ANIMAL PARASITES (HELMINTHS)

- (A) Nematodes ..
  - (1) Ascaris Lumbricoids—(Roundworm).
  - (2) Oxyuris Vermicularis (Enterobius)—Threadworm.
  - (3) Filaria (Wauchereria)—Bancrofti.
  - (4) Dracunculus Medinensis—(Guinea-worm).
  - (5) Ankylostoma Duodenale—(Hookworm).
  - (6) Necator Americanas—(Hookworm).
  - (7) A Braziliense—(Hookworm).
  - (8) Trichinella Spiralis.
  - (9) Trichuris Trichuria—(Whipworm).
  - (10) Strongyloid Stercoralis.
- (B) Cestodes ..
  - (1) Taenia Solium— Pigtape worm).
  - (2) Taenia Saginata—(Ox tape worm).
  - (3) Taenia Echinococcus—(Dog tape worm).
  - (4) Dibothrio Cephaluslatus—(Fish tape worm).

- 1. Blood flukes
  - Schistosoma haematobium
  - Schistosoma mansoni.
  - Schistosoma japonicum.
- 3. Intestinal flukes
  - Fasiolipsis Buskii.
  - Gastro discoides hominis.
- 3. Liver flukes
  - Distomum hepaticum.
  - Clonorchis sinensis.
- 4. Lung uukes
  - Paragonimus ringeri.
  - Paragonimus westermani.

NEMATODES

Ascaris Lumbricoides: *Life Cycle*:—The egg is the infective stage. Mature eggs containing embryo are ingested via contaminated food, vegetable and finger. The egg shells dissolve in duodenum, the embryos emerge, perforate the mucus membrane of intestine, enter lymphatics and veins reach right side of heart and lungs by the blood stream. It then penetrates the lung alveoli, migrate up the trachea down the oesophagus to reach intestine and become adults ready to lay eggs.

N.B.:—If the worm travels by lymphatic, it side tracks liver and goes into lungs but if they travel via veins, they go via liver first.

Oxyuris Vermicularis: *Life Cycle*:—The eggs are swallowed and larvae hatch out in duodenum. These pass down to caecum where they develop into adult worms, and attach themselves to the mucosa of caecum and large gut. But the females soon migrate outside the intestinal canal through the anus and deposit her eggs. The eggs remain attached to the skin in the groves around anus, Perianal hairs and hosts clothing. The host may be reinfected by contamination of fingers as a result of scratchin g and other members of the family in many ways.

Filaria (Wuchereria) Bancrofti Life Cycle:—The mosquito sucks the blood of an infected person during the night. The embroys (microfilaria) enter the stomach and soon migrate into the thoracic muscles where they pass through a series of development lasting for 10-14 days. These finally migrate to the proboscis of mosquito. When the mosquito bites, the microfilaria find their way at or near the site of puncture in the skin and eventually reach the large lymphatic trunks where they slowly grow into maturity (about a years or so). The female parturates and the embryos are carried via the lymphatic trunks into thoracic duct, into the general cirrulation.

Dracunculus Medinensis:—*Life Cycle*:—The embryos are swallowed by cyclopes in whose body cavity they undergo development. The infected cyclopes are swallowed by man in drinking water. The infected larvae escape out of cyclopes, pierce the intestinal wall and migrate to retroperitoneal and other tissues of the body of the host and develops into maturity. (8-12 months.)

When the female becomes gravid, it migrates to the surface of the body in those parts which are most likely to come in contact with water (Viz. legs and feet and shoulder region of Bhisty). At the site of choice the worm secretes an irritant

substance which gives rise to blister formations. The blister breaks, the uterus of the worm prolapses in contact with water and appears at the mouth of the opening and discharge a milky fluid swarming with larvae. These larvae pass into water and swallowed by cyclopes in the water and the cycle is repeated again.

Ankylostoma Duodenale: *Life Cycle*:—The eggs are passed in the stool by an infected person. The coiled up embryo appears inside the egg and the larva hatches out within 2-4 days. The larvae remain in the soil and develop further into an infected stage. The larvae enter human being through hair follicles, sweat glands or microscopic faults in the epidermis. They then enter a venule, carried via blood stream, reach the lungs, penetrate wall of an alveolus, migrate via bronchioles, trachea, oesophagus into the stomach and finally into jejunum where they attach themselves to the mucus membrane and develop into male and female adult worms. The female lay eggs in intestinal canal which are passed out. Time taken from the entry of larva to passing of first eggs is about five weeks.

N.B.:—The life cycle of Necator americanas is the same.

Prevention of Hook Worm Infection:—(i) Prevention of faecal contamination of soil, water, and of such food-stuffs as vegetables which are eaten uncooked.

(ii) Proper disposal of faeces by installation of sanitary latrines and enforcement of their use by population. In villages bored hole latrine would provide an adequate method of disposal of faeces. In Bucket removal system, cresol 2 per cent should be placed in the bucket or a layer of common salt on the bottom of the bucket and another when the bucket is full will serve the purpose.

(iii) Protection of water supply.

(iv) Personal protection of individuals by use of boots, shoes, sandals (wooden) would always decrease the chance of infection.

(v) *Publicity and Propaganda*:—To educate lay people, arousing their interest in the preventive side of this infection and to break the ingrained habit and actual prejudices.

(vi) *De-worming* (*Anthelmintic Treatment*) :—De-worming of infested persons as man is the sole reservoir of infection, would not only cure the individual but also eliminate the source of infection in the Community.

CESTODES

Taenia Solium: *Life Cycle*:—The proglottids (ripe segments containing uterus) are passed in faeces. These disintegrate liberating the ova which must be swallowed by a pig to complete its development. The egg shell is digested in the duodenum and the embryos set free. It penetrates intestinal mucus membrane, reach systemic circulation and finally gets encysted (cysticercus stage) in the muscles of the animal. These cysticerci are infective and men ingest them in raw or under cooked meat. From the cysticerci, worm develops and proceeds to grow into mature worm. Gravid prglottids are now passed out in faeces.

Taenia Saginatta; *Life Cycle*:—Dog is the definitive host. The egg is ingested by intermediate host, viz., sheep, pig, ox, man. The egg shell is dissolved and embryo set free in the intestinal canal. It penetrates the wall, reaches venules and enter the portal circulation. It may settle in the liver or pass into lungs, brain etc., where it develops into a cystic stage (Hydatid Cyst). Within these cysts brood capsules with scolices develop (complete head of the worm), which is capable of growing into an adult worm. When the intermediate host dies, or is killed and eaten by definitive host the scolices attach themselves to intestinal mucosa and develop into adult worm which discharges the proglottids or ova in stool.

TREMATODES

Schistosomes (*Blood flukes*): *Life Cycle*:—The cercariae (free living stage), enter through the skin when a person bathes in infected water. These reach systemic circulation by entering a venule or a lymphatic and reach the lungs. In the lungs these cross over and are carried once more to the heart, reach the intestines, cross over to portal system and reach the liver. Here they feed and develop, enter back into portal stream, migrate against the blood stream. These remain, grow and mate in mesenteric veins. Eggs are deposited in Intestine, but S. haematobium flukes reach vesical plexus via haemorrhoidal plexus so that ova are discharged into the veins of Bladder mucosa which break through bladder wall and are discharged in urine.

The ova thus passed in stool or urine come in contact with water when, from each ova a single ciliated larva (miracidium) hatches out. These miracidi enter certain species of Snails where they enter into a cystic stage for development. The worms develop and finally burst out of snail (cercariae) in Swarms in the water, ready to attach themselves to the skin of the legs of a bathing or wading human being.

CHAPTER NINE

DISINFECTION AND DISINFESTATION.

DEFINITIONS:—

(i) *Disinfection*:—Prevention of infectious disease by destruction of the causative micro-organisms.

(ii) *Disinfestation*:—Connotes destruction of ectoparasites like lice, etc., and their ova.

(iii) *Disinfectant*:—Substances which destroy micro-organisms.

(iv) *Deodorant*:—Substances which prevent or mask putrefactive odours (not necessarily possessing any disinfecting or antiseptic properties).

(v) *Antiseptic*:—Substances which inhibit the growth and multiplication of organisms (without necessarily destroying them completely).

(vi *Sterilisation*:—Means destruction of all microbic life on or in an object.

Concurrent disinfection:—means immediate disinfection and disposal of all infected material during the course of an illness, viz., sputum, faeces, nasal discharges, etc.

Terminal disinfection:—means disinfection of room with its contents and the premises after the recovery or removal from the sick room of a case of infectious disease.

Methods of Disinfection:—

Classification—

- (A) Physical agents
  - (i) Sunlight
  - (ii) Heat
    - Dryheat-burning
    - Moist heat
      - steam
      - boiling
- (B) Chemical agents
  - (i) Solids
  - (ii) Liquids
  - (iii) Gases

(A) *PHYSICAL AGENTS*:—

(i) *Sunlight*:—disinfecting power of sunlight is due to the sterlising action of ultraviolet rays and desiccating effect of heat rays. But this is slow in action and certain organisms are very resistant, hence unreliable

(ii) *Dry heat*:—burning is a rapid method of disinfection and disinfestation but has only a limited applicability.

(iii) *Moist heat*:—Boiling is an effective method of destroying infection of all kinds. An exposure to boiling water at 100°c for an hour will destroy practically all the germs of infectious diseases. Boiling is an useful method of disinfecting surgical instruments, bed clothings, body linens and similar other articles.

Steam disinfection:—This is the method of choice for disinfection. Steam disinfectors nowadays used are of high pressure saturated steam. Saturated steam is steam in contact with water from which it is generated. It has a great power of penetration. It has the properties of a vapour and so its temperature varies directly as the pressure to which it is subjected. When saturated steam comes in contact with any object colder than the boiling point of water, it immediately condenses into water and transfers its latent heat to the object. The latent heat of steam is 537°C per c.c. so a large amount of heat is transferred to any article colder than the boiling point of water, exposed to a continuous stream of steam. Actual contact with saturated steam is fatal to all organisms. The steam condenses in contact with objects and on condensation it contracts to 1|1600 parts of volume thus creating a partial vaccum into which more steam immediately rushes, condenses in turn and again creates a partial vaccum. This continued repetition plays an important part in penetration throughout the mass of object. The goods are usually exposed to a current of saturated steam at a pressure of about twenty lbs. at a temperature of 123° to 125°C for some 20 minutes to half an hour.

How to test the efficiency of the machine?:—By placing in the centre article to be disinfected, a piece of gauze smeared with cultures of various organisms usually B. Subtlis which after disinfection should show no growth in suitable media.

Continuous current steam: steam produced without any pressure i.e., at atmospheric pressure.

Saturated high pressure steam:—Steam employed under pressure i.e., above atmospheric pressure by obstructing the outlet of steam until the desired pressure is obtained (as boiling water in a closed chamber—steam boiler) the saturated steam because of its condensation by coming in contact with colder objects contracts to 1|1600 part of its volume and creation of a vaccum, has a greater penetrating power and is always prefered for disinfection.

Super-heated steam:—This is the steam produced by conversion of all water in the container into steam and raised to a high temperature. It has no condensation power, hence no contraction in its volume, consequently less penetrating power. So it is an inferior disinfector than saturated high pressure steam.

(B) *CHEMICAL AGENTS*:—

I. *Solids*:—These are—Lime; Mercuric chloride (perchloride of Mercury). Mercuric lodide (Bin lodide of mercury). Pot permonganate ; Bleaching powder ; D.D.T.

II. *Liquids*:—Cresol; Izal; Phenol, Cylin, Lysol, Formalin.

III. *Gases*:—Sulphur dioxide; Formaldehyde; Hydrogen cyanide, ethylene oxide.

(I) *Lime*:—It is the cheapest and powerful disinfectant either alone or with chlorinated lime used for disinfecting water; as a lime wash (I part of slaked lime with 4 parts of water) for ceilings, floor and the walls of rooms, for disinfecting byres and stables after occurrence of a case of anthrax. It is also used for disinfection of faeces. 20% solution do it in an hour or by thorough mixing of equal parts of stool and lime and allowing to stand for 2 hours.

(2) *Perchloride of mercury*:—It is a powerful germicide. 1 in 1000 solution will kill organisms in ½ hour and spores in one hour. But it is poisonous and corrodes metals, form insoluble compounds with albuminous matters and hence not suitable. Its use is mostly confined as a disinfectant for hands of those employed in nursing infectious patients.

Formula of 1 in 1000 solution—Mercuric Chloride—70 grs.
Hcl. acid—3 drachms.
aqua—to 1 gallon.

N.B.:—the acid is added to increase solubility. It is always tinted blue with commercial aniline dye (1 gr. to a gallon) to give it a distinctive colour to prevent accidents.

(3) *Pot Permanganate*:—Its disinfectant and deodorant power depends upon its oxidising power but contact with organic matter rapidly deprives it of its oxygen. It is relatively expensive but non poisonous and non irritant to man. It is mainly used for disinfecting wells, for washing fruits and vegetables which are eaten raw. But to be effective it must be freshly made up and contact maintained for ½ hour in 1 in 100 strength. Condys fluid is a proprietory preparation

consisting of a solution of sodium permanganate in a strength of 1 in 60.

(4) *Bleaching powder*:—It is mainly used for sterilising water. (For details see under water chapter).

(5) *D.D.T.* (Dichloro diphenyl trichlorethane):—It is a white crystalline powder and a most efficient insecticide with a remarkable and persistent lethal action on all kinds of insects and larvae. Its residual effect enhances its value greatly. Insects walking on D.D.T. pick up the poison mostly through tactile sensory organs of the tarsi, and insects flying into a mist containing D.D.T. pick up on their wings but as the legs are used for cleaning, end result is the same. Death is due to failure of respiration which is not immediate and appears after an interval varying with the dosage and type of insect.

Mode of use:—(1) as a powder—consisting of 10% D.D.T. mixed with inert diluent powder—viz, talc, calcium carbonate or chinaclay.

(2) as a spray:—(against flies and mosquitoes). Pure D.D.T. in 5% oil of sesame dissolved in Kerosine preferably with 5% pyrethrins for a "knock down" effect.

(3) as a residual spray—5-10% D.D.T. in Kerosine.

(4) as aerosol mists and smokes:—in the form of "aerosol bomb" or Freon bomb. 1-5% D.D.T. mixed with liquefied gas (dichlor diflour methane) in a closed container. It forms a fine mist of droplets which disperses well in a closed room.

Liquids:—(1) *Phenol*:—It is the crystallisable portion of crude carbolic acid (derived from benzene). In 1 in 100 solution at 37°C Phenol will destroy organisms other than spores in 20 minutes. 1 in 20 solution may be used for disinfecting clothing, bedding. It does not harm fabrics but stains clothing ,'Crude Carbolic acid is a mixture of Phenol; ortho, meta, Para cresols and tar oils."

(2) *Cresol*:—It is the liquid portion of crude carbolic acid used in 2½% solution for disinfection.

(3) *Lysol*:—contain 50-60% cresol and is used in 1% solution for disinfecting purposes.

N.B.:—coaltar derivatives—this group includes aniline dyes, phenol and the cresols, all of which are obtained by fractional distillation of coaltar.

Carbolic acid co-efficient (Rideal Walker test) This is the test employed to assess germicidal power of any chemical. In this test the power of the chemical in question to kill a

standard dose of standard strain of B. Typhosus in standard time at a standard temperature is compared with the killing power of phenol under identical conditions.

For example if a cresol diluted to 1|1200 and phenol diluted to 1|100 both produce sterility say in 15 minutes, R.W. co-efficient of cresol is 12. This means that acting on the same organism and under same conditions cresol has 12 times the disinfecting power of phenol.

(4) *Formalin*:—It is a 40% aqueous solution of formaldehyde gas and is powerful disinfectant but very irritating to hands, respiratory passage etc. It is not much used as a general disinfectant but in 5% solution may be used as a spray for disinfecting roof, walls, floor etc., for spraying fur-coats, leather and rubber goods; books, musical instruments, paintings etc. It does not harm coloured articles.

III. *Gases*:—Disinfection by gas is termed fumigation.

Fumigation:—The gaseous method of disinfection by chemicals is called fumigation. It has a wide range of application in disinfecting, rooms, ware houses, holds of ships, granaries, railway carriages etc. The gases commonly used are sulphur dioxide; Formaldehyde, hydrogen cyanide and ethylene oxide.

Precautions:—Before disinfection rooms should be properly prepared by closing all doors and windows and having every crack and fissure sealed by pasting papers. The doors and windows should be kept closed for at least six hours after fumigation and then kept open for ventilation.

(1) *Formaldehyde*:—It is the only germicidal gas which can be used without fear of injuring musical instruments, paintings, woolen goods and all objects of art and value. It is cheaper, effective, does not, bleach textiles or act on metals. It may be used in either of the following ways.

(a) *Permanganate method*:—(Autan process) 10 to 15 ounces of 40% formalin diluted with equal amount of water are poured over 5 ounces of pot. Permanganate crystals in a deep metal jar when sufficient formaldehyde gas is generated adequate to disinfect 1000 cft.

(b) *Bleaching powder method*:—Two pounds of bleaching powder is at first made into a paste with water in an iron vessel and two pounds of formalin is next poured on it when the gas generates sufficient to disinfect a room of 1000 cft.

(c) *Alphormant lamp*:—This is a lamp of special construction consisting of a (1) copper container which is enamelled and perforted for the gas to escape. Paraform tablets (Para formaldehyde—30 tablets: 1 tab=1 gm.) are placed inside it. (2) a burner with a small cup and wick for lighting with methylated spirit. The burner is left burning overnight and the gas is produced.

(2) *Sulphur Dioxide*:—It is mainly used for disinfecting ships, ware houses (destruction of rats in plague infected ships) cars, stables and outhouses infested with vermin. It may be used in either of the following ways.

(a) *Pot method*:—Iron pots are placed on tubs of water which are placed at a much higher level than the floor as the gas is heavy. Water supply moisture to hydrate sulphur dioxide and the gas is obtained by burning sulphur, three pounds of sulphur when burnt give 2% concentration sufficient to disinfect 1000 cft.

(b) *Clayton's apparatus*:—This is the best method. Sulphur is burnt in an iron generator and a forced draft from a blower ensures complete combustion of sulphur. By means of pipes led from the generator into the room, ship or warehouse etc. the room air is sucked out repeatedly and sulphur dioxide gas is released again and again. Its disadvantages are: it tarnishes metals, discolours paints, injures grains and entails a risk of fire.

(3) *Hydrocyanic acid gas*:—It is a valuable disinfectant and used particularly against rats in ships, bugs in houses. It is an extremely dangerous poison and should be used only by a team of experts. The gas can be generated in the following ways:—

(i) Liquid hydrocyanic acid pumped from Cylinders.

(ii) By special apparatus—e.g. Grubb's generator or Liston's apparatus.

(iii) By adding sodium cyanide to a mixture of sulphuric acid and water. The water is first added to the containers, then acid and finally cyanide in the proportion.

Sodium cyanide	..	..	.. 2½ ounces
Sulphuric acid	..	..	.. 3½ „
Aqua ..	..	..	.. 5 „

Sufficient for 1000 cft with exposure for 2 hours.

(iv) *Cyano gas*:—Or Zyklon—Proprietory hydrocyanic acid. In this some absorbent inert base saturated with liquid hydrocyanic acid and some tear gas is used. One and half ounce is sufficient for 1000 cft with an hour's exposure.

N.B.:—The presence of hydrocyanic acid gas is tested by benzedine copper acetate solution which gives blue colour on exposure before allowing the use of the room or hold of the ship.

(4) *Ethylene oxide*:—Fumigation by this gas is of value in destruction of insects particularly those affecting dried fruits. It should not be used except by a team of experts. Its advantages are that it is not poisonous to man and does not leave any poisonous after effects on fruits treated.

Special and practical methods of disinfection:—

(1) *Bedlinen; clothing etc*:—Fouled with infectious discharges exudates viz, blood, pus etc. At first should be steeped in 2½% cresol for half an hour or immersed in 5% phenol, 10% formalin or 1 in 1000 perchloride of mercury and finally boiling for ½ hour or disinfected by saturated steam.

(2) *Crokery and Cutlery*:—(Knives ; forks etc.)—Soaking in 1% formalin for two hours or steeping for half an hour in 2½%cresol followed by washing in hot water with soda (1% soda).

(3) **Excreta** *and discharges*:—(a) *Sputum*—to be received in sputum cups containing 2½% cresol and burnt afterwards in saw dust and Kerosine or Gauze Swabs. (b) *Nasal discharges*:—to be burnt after receiving directly in gauze or cotton wool swabs. (c) *Excreta*:—to be mixed with equal quantity of 2½% cresol and allowed to stand for half an hour or with 5 to 10% phenol or 10% formalin and allowed to stand for 1-2 hours and finally thrown into water closet, disposed in a pit or incinerated. May also be mixed with equal quantity of freshly prepared lime (1 part of lime to 4 parts of water) or with 3% Bleaching powder and allowed to stand for 2 hours before being finally disposed by above ways.

(4) *Infected Room*:—(1) Fumigation; (2) 5% formaldehyde spray. (3) Walls and floors are disinfected, by washing and swabbing with 1 in 1000 perchloride of mercury, 3% chloride of lime and 2½% cresol. In a mud house walls and floor to be scraped and burnt, followed by mud plastering and lime wash.

(5) *Leather goods, books, toys, picture frames musical instruments, woolen goods etc*:—Fumigation by 5% formal-

delyde preferably by paraform method or by 5% formalin spray followed by exposure to air for 2-3 days.

(6) *Privy and Drains*:—Scrubbing and washing with 1% lysol, phenyle; bleaching powder and cylin 1 in 100.

(7) *Rubber goods*:—(i) by boiling in 3 to 5% phenol for ½ hour (ii) by steam.

(8) *Shaving brush*:—Washing in 5% soap solution with 1% soda at 120°F. allowing it to stand in 1% soda solution for ½ hour at same temperature, then soaked in 10% formalin for another ½ hour at same temperature and finally allowing it to dry in shade with bristle downwards.

(9) *Thermometer*:—Washed and kept in 1 in 20 phenol for an hour or in absolute alcohol.

(10) *Wood work*:—(Furniture)—Washing with soft soap and boiling water, or formalin spray.

Duckering Disinfection:—It is a complicated process of disinfecting imported wool. The process is summarised below —(i) opening the material without handling, by machine (ii) washing in ½% sodi bicarb solution to remove albuminous coatng of spores, then by soap and next by 2% formaldehyde solution twice and finally by clean water to remove excess of formaldehyde (iii) passed through hot air machines for drying next (iv) through cooling machine (v) Rebailing by machine.

CHAPTER TEN

HEALTH AND EXERCISE

Health:—*Definition*:—It is defined as something more than mere physical fitness and mere absence of disease. It is a dynamic and active state of living. It is a state of physical, mental and spiritual fitness, a harmonius adjustment of the individual to social environment. Fitness means a condition created by the combined influences of wholesome food, good sleep perfect rest, regular exercise and absolute cleanliness both inside and outside the body.

Effects of Exercise:—Exercise is neecessary for the different organs of the body to work effectively and to develop a good body. The effects of exercise on various systems are as follows:—

(1) *Muscular System*:—Increase of blood flow leading to better nutrition and growth of muscles—(by increased supply of oxygen) and keeping up the healthy tone of the body.

(2) *Circulatory System*:—Increased venous return, increased cardiac output, increased rate and force of contraction. The entire system is coordianted to one main action—to increase as far as possible the blood flow through tissues and is attained by combination of several factors vz; Respiratory, circulatory and venous pumps; auricular reflex of heart, vaso motor nerves, peripherally acting chemical dilator agents.

(3) *Cutaneous system*:—The arterioles of skin and splachnic area are initially contracted and blood is mainly driven to heart but when the body temperature rises due to increased muscular activity after exercise skin vessels dilate to facilitate heat loss.

(4) *Respiratory System*:—Increased carbon dioxide tension and increased ventilation of lungs—in direct proportion of severity of exercise. After the exercise is over breathing rapidly settles down to the resting level and excess of Co_2 is eliminated.

(5) *Alimentary system*:—Constipation is corrected and a regular action of bowel is ensured.

(6) *Nervous system*:—improves the mental capacity to work.

SCHOOL HEALTH PROGRAMME

The school health programme can be grouped under following heads:—

(1) Medical inspection including prevention and treatment of diseases.

(2) Establishment of school clinics.

(3) Adoption of special measures.

Medical Inspection:—Every pupil admitted for the first time shall be inspected as soon as possible after admission and during last year of his attendance or any such other occasion necessary with a provision for following up of pupils, found on inspection to need supervision and treatment, referring to specialist in respect of whom further advice is needed. Medical inspection of pupils include the following:—general condition,—i.e. name, age, sex, religion etc.; nutritional state, height, weight, general cleanliness; infestation by lice in girls. condition of teeth, nose, throat, eyes for vision with and without glasses; condition of heart and lungs; spleen and liver; gait, posture, and any deformity and finally psychological development; stability, mental defect. Medical inspection of an educational institution include inspection of the building; the class rooms, drainage, water supply, ventilation etc., so that proper hygienic conditions for the pupils could be maintained at school. The class rooms for thirty children should provide 16 sq. ft. (floor space) per child, well ventilated by means of windows, placed on opposite sides and made to open into external air. Lighting should be natural in such a way that a portion of sky must be visible at the desk or table height. Windows for lighting desk should be either on left or right side.

Seats and desks must carefully be made, as unsuitable furniture may give rise to errors of posture. Height of the desk should be elbow height or little above; breadth should be 15-18 inches (half the length of forearms and out stretched fingers) so that a student should be able to write without raising shoulders. The slope should be of 10 to 15° for writing. Back rest should support general curve of the spine with the support as high as shoulder blades. Each seat should be 1½ feet apart.

School Clinics:—The study of practice of health forms the first part of every day life in school. Hygiene should be taught systematically by holding classes once a week. Lectures on first aid and other useful informations necessary for maintaining a hygienic standard of life should be imparted in these

school clinics. Remedial treatment for physical deformities, special classes for physically handicapped or submental child requiring special education and treatment should be undertaken by the school clinic. Physical education by physical instructors also need medical attention and supervision for suitability.

Special measures:—This is to be taken during epidemics of infectious diseases when isolation, inoculation and other preventive measures are undertaken and rectification of sanitary defects responsible for it are carried out.

N.B.:—Students mostly suffer from mal-nutrition enlarged tonsils and adenoids ; defective vision ; Caries tooth and pyorrhoea alveolaris; tuberculosis and malaria.

MATERNITY AND CHILD WELFARE.

Both mother and child need protection and help before during and after birth, hence the importance of special health measures for mother and child leading to formation of maternity and child welfare centres. The centres are essentially necessary to avoid permanent and temporary injury to mothers from the after effects of pregnancy.

Maternal welfare is done by antenatal care in these centres which means care of a pregnant mother and implies thorough examination of a pregnant woman, supervision throughout the period of pregnancy with the object of preserving the health of the mother, as well as that of the future off-spring.

Maternity welfare centres should have following:—

(i) Arrangement for local supervision by midwives.

(ii) Arrangement for ante natal clinic under a Lady Doctor and home visiting by health visitors.

(iii) maternity hospitals in which complicated cases of pregnancy can receive treatment.

Expectant mothers should register their names and then taken care of and advised by the Doctor. The Lady doctor should examine, then advise and treat them as and when necessary; also advise midwives and health visitors and help them in their difficulties in conduction of labour cases at home. Mothers should also be given a talk, if necessary by charts, models, posters etc., about mother craft and child rearing and educated regarding the hygiene of pregnancy, diet, rest exercise, clothing, care of nipples, bowels and personal cleanli-

ness. In natal period confinement may be at home or hospital. Midwives should conduct all normal cases and in case of abnormality doctor should decide to conduct herself at home or hospital.

In post natal period after everything is normal lady health visitor should take them under her care. At first visits daily, then weekly, next fortnightly, monthly and lastly quartly advising them to attend the clinic in cases of difficulties and illness which are taken care of by the doctor. During home visiting health visitors should see that mother and baby are well looked after in their homes in a good environment and persuade them to attend centres for treatment when necessary.

The ante natal examination should be done twice a month from 5th to 7th month, then weekly up to the time of confinement.

Advantages:—By antenatal examination and advice mothers may be kept healthy during pregnancy, minor ailments relieved, major ones like eclampsia can be prevented; difficult labours may be foreseen, abnormal positions may be corrected. Contracted pelvis can be diagnosed and suitable treatment adopted, thus reducing maternal morbidity and mortality due to difficult labour and puerperal sepsis. Number of still births, miscarriages and neonatal deaths can definitely be reduced.

N.B.:—Commonest causes of maternal death are anaemia and puerperal sepsis.

POSTSCRIPT

Maternal mortality and foetal mortality rates can be reduced only by constructive efforts of the state authorities and co-operation of the public. The maternity service includes establishment of Maternity Homes and organised maternity service by maternity trained nurses and medical practitioners having training in the maternity hospitals or knowledge of maternity service. The service in the town or a big city like Calcutta is different from that of mofussil.

As the majority of population are living in villages and their economic standard is very low and they also take the greater share in the maternal mortality of the country, we should think first how we could best possibly tackle the problem of maternity service in the mofussil area.

The maternity service in the mofussil area can be organised in the following way:—

(1) Village union centre—A union which is consisting of several villages should have a maternity home consisting of four beds managed by two trained midwives and one maid servant. One of the midwives will be working in the maternity home and the other will attend each village twice in a month. She will take care of pregnant mothers from the very beginning of pregnancy. She will not only take ante-natal, post natal and neo-natal care but also give teaching about maternity and child welfare to the village women folk.

(2) Thana Maternity Service—A maternity unit in a thana (over several union) consisting of a minimum 10 beded maternity home with provision of attending difficult and complicated cases. There will be one maternity trained medical officer, three midwives and one sweeper for the maternity home.

This thana maternity units will cover most of the mofussil towns as all these towns have one 'thana'. This thana unit will do all the maternity cases of the local union and complicated cases of the union maternity unit under the particular thana, also if possible, domiciliary maternity service is to be given by the maternity unit. The maternity unit in mofussil towns will run one ante-natal, clinic and the unit will try to educate the public about the importance of taking maternal care in the ante-natal and post-natal period and also the infant care in the neo-natal period.

For proper conduction of maternity homes, there should be also blood transfusion service. This can be organised in one district town in co-operation with maternity service unit and general hospital unit of the town.

If we look into the maternity services in Calcutta, we find that though there are good number of Maternity Hospitals in Calcutta, and some of them are well-equipped, they are inadequate for the vast population in Calcutta and not all of them are well-planned. A very good maternity service in one area would include a very good ant-natal and post-natal service. So it will not solve the problem for aiming at proper maternal care by only establishing a home for confinements. Unless there are proper ante-natal care, the incidence of complication during pregnancy and labour will remain the same.

The maternity service in a big city may be planned in the following way:—

There should be a maternity home consisting of 10 to 15 beds with a midwive and one midwifery trained medical officer for one or two wards of the Municipal Corporation.

The whole idea of organisation of maternity homes in mofussil and in towns, in the above way, is to give proper maternal and infant care as far as possible and to screen out the abnormality in the ante-natal period and also during labour and refer them to the properly equipped and manned maternity homes and hospitals in time, so that timely aid will save many mothers from catastrophies.

The importance of good maternity service is gradually being organised. Recently some maternity homes have been opened in the municipal area near Calcutta. They required regular help from obstetrical consultant for advice.

It may not be possible to start maternity homes in every union, but in every thana, a small maternity home can be started and this will serve the people under the thana to some extent. Gradually maternity centres in everyone or two unions have be established. If the public find the benefit of their service they will be encouraged to help the maternity service to grow.

There are large number of experienced obstetric specialists in a big city like Calcutta. The State Government can form a pannel of them and request for their service, of course without any remuneration for the little service for their country. They will be requested to go to mofussil centres, once in a month to organise, supervise and stimulate the maternity centres. They will also give educative lectures on the importance of good maternity service. Their conveyance charges will be paid by the State or local authorities.

CHILD WELFARE CENTRE

These should be opened in as many places as possible under the supervision of health visitors, one centre should cater for 200-250 births. Health visitor should visit homes on receiving the information regarding the notification of birth in her area. She should pay fortnightly visits for first six months, monthly for 6-9 months and half yearly until the child is five. Mother also should attend the centre every 4-weeks for 1st year and thereafter every 3-6 months.

Arrangements should be made for free distribution of dried milk, codliver oil and fruit juices or supplied at cost price by voluntary organisations like Indian Red Cross Society through these centres.

The children upto 5 years of age should be periodically examined medically, weighed weekly, given instruction re-

garding diet, clothings, cleanliness etc. Inspection should also be made regularly to detect any sign of infectious disease. This can easily be done through "Day Nursery" schools.

Children after 5 years may preferably be trained in infant nursery schools.

Finally in these centres mothers should be taught to observe signs of normal development of the babies, to manage breast feed, to supplement her own diet and that of the child including preparation of feeds for the baby.

N.B.:—Common causes of infant mortality are, Prematurity. Gastroenteritis and Respiratory diseases.

CRECHE:—This is an organisation set up by industrial authorities as a welfare measure for working mothers. Creche is a sort of public nursery for children while their mothers are at work. This usually accommodates 56-250 children up to 5 years age and looked after, with a provision for washing and changing of clothes and facilities for the mother to feed the children there. Supply of free milk to children and trained nurses to feed the baby and look after them are also provided in some of them.

CLIMATE AND HEALTH

Climate:—The climate of any place depends upon combined effects of sunshine, wind, atmospheric pressure, temperature and humidity. Each modifies the other and all are influenced to a greater or lesser extent by the nature of earth's surface in the vicinity.

Temperature:—The atmospheric temperature of any place depends primarily upon sun, modified by latitude, altitude, wind, topography, movements of ocean currents, rainfall and humidity.

Measurement of temperature:—Two scales for measuring temperature are commonly used—(i) Farenheit and (ii) Centigrade.

Conversion:—Depends on freezing and boiling points of those two scales.

(i) Centigrade:—freezing point is 0°C and boiling point 100°C.

(ii) Farenheit:—freezing point is 32°F and boiling point 212°F.

To convert centigrade into farenheit= $\frac{5\,(F-32)}{9}$ i.e. deduct 32, multiply by 5 and divide by nine.

To convert fareinheit into centigrade= $\frac{9\,(C+32)}{5}$ i.e. add 32, multiply by 9 and divide by 5.

Temperature is measured by thermometers. Maximum thermometer for highest temperature, minimum thermometer for lowest temperature, combined maximum and minimum thermometer for both (James Six's) thermometer.

Atmospheric pressure:—On an average air exerts pressure of about 147 pounds per square inch of earth's surface. If an atmosphere could be supplanted by a sea of mercury 760 m.m in depth, same pressure would be exerted. It is for this reason, normal atmospheric pressure is known as 760 m.m. It can be measured by barometer, the pressure depends on temperature and moisture it contains.

Humidity:—It is the presence of moisture in air. The air gains moisture by evaporation of water vapour from the surface of ocean and other surface collections of water. The amount of water vapour absorbed by air depends on its temperature. Higher the temperature greater is the water vapour it can hold.

Absolute humidity:—This is the amount of water vapour actually present in the air and expressed as grammes per cft or grammes per litre of air:—(actual weight of moisture present per cubic ft. of air).

Relative humidity:—It is the ratio expressed as percentage of water vapour actually present in the air at any given temperature, to the amount that would be present, were the air saturated at the same temperature. (Percentage of amount of moisture in air regarding saturation as 100.) E.g: At a certain temperature air held 6 gramms of moisture per cubic foot but if at that temperature it would not become saturated until held 8 grm per cft. so it is only $\frac{3}{4}$th saturated i.e. relative humidity is 75%.

Residual absorptive capacity:—The amount of water vapour that can be absorbed over and above the absolute humidity at a given temperature.

Humidity can be measured by hygrometer (Mason's).

Dew point:—It is the temperature at which the air becomes saturated with moisture.

The cooling power of air is determined by Kata thermometer. (See under air).

Pressure and velocity of wind can be measured by Anemometer.

Rainfall:—This is expressed in terms of inches and is measured by a rain gauge-one inch rainfall means collection of 4 2|3rd gallon of water per square yard. The average rainfall of India is 42 inches.

VITAL STATISTICS

Def:—Vital statistics is the science of recording in a graphical way vital events such as birth, population, death, sickness etc in the life history of a community.

Importance:—It supplies information as to the health of the people, as to the good and bad conditions affecting the people. It records average life span of a community necessary for life insurance. It gives the morbidity and mortality rates of different diseases and enables us to take timely precautions against diseases and finally provides records of past events necessary for comparative study.

Death Rate:—It indicates number of deaths per year per 1,000 from all causes of mean population. This can be expressed as. $\frac{\text{No. of deaths registered in a year} \times 1000}{\text{Mid Year Population.}}$

Mid year population:—This is determined by arithmetical progression. It is worked out as difference between last two census figures plus 7,500 ($1000 \times 7\frac{1}{2}$) as it stands on first July (mid year). The census is taken every 10 yrs—It was done in 1941 and again in 1950-51.

N.B.:—Death information is registered and recorded by chowkiders or president union board, Police stations and thana sanitary inspectors and subregistrars at burning ghats. In hospitals death information is given within 12 hours but in other cases it is to be within 8 days.

Specific death Rate:—This is expressed as:—

$$\frac{\text{No. of death in age periods (0—4 years)} \times 1000}{\text{Population at ages (0—4 years)}}$$

Mortality due to specific causes amongst selected group of persons specified according to age, sex etc., specific death for each age period of life indicates at what particular age problems of health mostly arise.

Biological death Rate:—It means nature's unavoidable death which can not be lowered by any means.

Standardised death Rate:—(Comparative mortality index) Here the death rate is corrected and adjusted for age, and sex. The highest mortality takes place in two extremes of life,

females as a whole have a lower death rate. Death rate is low in urban area while in rural area it is high due to large number of old people residing there so correction is necessary for these irregularities of distribution as regards age and sex, otherwise death rate will afford no accurate means of comparing healthiness of one district with that of another. The death rate so adjusted is known as standardised death rate.

Infant Mortality Rate (I.M.R.)—It means death of infants under one year of age per 1000 registered live births per year and is expressed as:—

$$\frac{\text{No. of registered deaths of infants under 1 year} \times 1000}{\text{No. of registered live bierths.}}$$

Maternal mortality Rate:—It means number of deaths of women due to pregnancy and child bearing per 1000 live and still births registered in that year. This excludes deaths from other causes which are not ascribed to pregnancy or child birth.

Thus:— $\frac{\text{No. of deaths of women due to pregnancy or child birth} \times 1000}{\text{No. of registered live and still births in a year.}}$

Birth Rate:— $\frac{\text{No. of births in a year} \times 1000}{\text{Mid Year Population.}}$

Natural increase of population:—Excess of births over deaths.

Actual increase of population:—Excess of birth over deaths plus the emigrants.

Decadence of population:—Increase of deaths over birth.

Figures:—

	Birth Rate Per 1000 Population.	Death Rate Per 1000 Population.
1948	25.2.	17.0.
1949	26.2.	15.8.
1950	25.5.	16.7.
1953	22.9.	10.3.

Infant Mortality Rate per 1000

1948..... 130.
1949..... 123.
1950..... 137.
1953..... 93.7.

Maternal Mortality (per 1000 of total birth)

1947..... 7.
1953..... 4.9.

Death Rate from Prevalent diseases (per 1000)

	Malaria	Cholera	Small-Pox	Tuber-culosis.
1947 ..	3.9.	0.5.	0.1.	0.4.
1953 ..	1.1.	0.3.	0.025	0.3.

Density of population 806 per sq. mile. (In 1950).

CHAPTER ELEVEN

REFUGEE CAMP SANITATION

The following points are to be considered in connection with camp sanitation.

(i) *Selection of Site*:—The camp site should be on a high ground not subjected to flooding or water logging. A dry land with a slope for proper drainage is always preferable. It should have a good approach to main road or a raliway station for easy transport and availability of supply. The most important factor to be looked into is the facility of getting water in the neighbourhood.

(ii) *Accommodation*:—May be tents or huts with 30-40 sq. ft. of floor space per man. Tents or huts should at least be 10 ft. high. Floor should preferably be covered with a layer of bricks cemented together. Drains to be cut round the huts to hold rain water and allow surface drainage. Kitchen should be at one side and the conservency area at the other end, away from source of water supply and 200 yds away from nearest sleeping place.

(iii) *Water Supply*:—Pure water supply is essential. Deep tube wells are best if funds permit. Otherwise reserve tanks for drinking and others for bathing and washing. Deep wells would also serve the purpose well but should be disinfected periodically by bleaching powder. Boiling of water and chlorination is always safe irrespective of the nature of supply.

(iv) *Food and Cooking Arrangements*:—Provision for fly proof storage of food, proper washing arrangement of the utensils with provision for allowing all sullege water to pass into Soakage pits are important.

(v) *Conservancy*:—Dry refuse to be collected in gunny bags and Kitchen refuse in metal receptacles, to be disposed by burning in deep pits at a distance or incinerated. Of the liquid refuse urine should be disposed in Soakage pits, night soil by water carriage system if it exists, otherwise by trenching system. Deep trench latrines, made fly proof, roofed, walled or partitioned can be used as latrines with advantage. Bored hole latrine is good when subsoil water is not high (1 for 12 persons).

(vi) *Medical Arrangement*: would scrutinize all factors endangering life of the refugees and take steps accordingly.

Preventive action combined with isolation of patients with quarantine of the contacts in case of infectious diseases are to be enforced. Inoculation against Cholera, and typhoid and vaccination against small pox are important protective measures to be followed rigidly. There should also be one out door treatment centre, preferably with an indoor hospital attached to it or arrangements for sending them to the nearest hospital.

Finally regular health talks to the camp inmates, impressing upon them the importance of living a hygienic life and the utility of preventive measure against the outbreak of Epidemic diseases are to be given as an educative measure.

SANITATION OF FAIR (MELA)

Preliminary work is to be done by drawing a regular plan of work previously by constituting a mela committee who would carry on the ground work. Long before the opening of mela, the pilgrims are to be advised by posters and newspaper advertisements.

The following are to be particularly attended to in arranging for the sanitation of a mela.

(i) *Control of pilgrim traffics*—Inoculation of pilgrims against cholera, typhoid and vaccination against small pox must be rigidly carried out before the pilgrims can reach the mela by inoculating them in railway stations, steamer ghats and the mela premises.

(ii) *Accommodation*:—After selection of site the whole area should be divided into seperate plots and each plot kept under the supervision of a sanitary inspector who will be responsible for all sanitary measures, and supervision in that area, particularly with regard to water supply, privy accommodation and arrangement, refuse disposal, inoculation, detection and removal of patients suffering from any infectious diesease.

(iii) *Medical and Sanitary Arrangements*:—Daily inspection by officer in charge to find out any suspicious case of illness, and receive reports from sanitary officers: Any infectious case should be removed to a hospital with arrangement for isolating infectious cases. First aid treatment centres should be opened in different sections of the mela—with an outdoor treatment centre and medical inspection room.

(iv) *Water Supply*:—Deep tube wells in absence of filtered water supply is ideal. Existing Kaccha wells if any are to

be closed or treated with bleaching powder and new wells sunk. All well water to be disinfected regularly by bleaching powder before the opening of mela. If there were existing tanks few to be reserved for drinking only.

By arranging for big galvanised iron tank with taps, regularly filled with purified well or tank water and installed in different sectors of mela—the problem of water supply may be made easier.

(v) *Conservancy*:—Latrine sites to be selected previously and supervision left in charge of sanitary inspectors, deep trench latrine is the best (one for 100 persons). Earthern were gamla on ground with bricks as foot rest, placed on rows with bamboo matting partitions can be used as a temporary measure for a short period. For urinals 4-6 ft, pits filled with Jhama or a perforated Kerosine tin full of Sawdust soaked with perchloride of mercury and sunk in the ground serve the purpose well.

Night soil to be disposed either by burning or trenching.

(vi) *Publicity and Propaganda*:—To be done in the mela grounds by loud speakers, cinema shows, picture posters etc. exhorting the pilgrims to follow the hygienic principles.

VILLAGE SANITATION

Any scheme for the improvement of sanitation in villages should embrace the following:

(1) *Mass education*:—The people should be convinced by lantern lectures, that most of the diseases from which they suffer are preventible and thousands of life colud be saved annually. The dangers of insanitary habits, harmful effects of overcrowding, the effects of ill ventilation, unhygienic surroundings ; pollution of water supply should all be impressed on them forcibly. Elementary knowledge in hygiene may profitably be introduced in village schools.

(2) *Rural Town Planning*:—Government should construct some model huts and give incentive for planned construction of well ventilated houses with a courtyard, a kitchen in one end and a privy at other corner away from residing room and kitchen with proper drainage.

(3) *Water Supply*:—Provision of pure water supply for drinking and cooking is a life saving measure. Model tanks ; deep wells or tube wells to be kept under proper supervision and reserved for drinking purposes only. Regular disinfection by bleaching powder should be maintained.

(4) *Conservancy*:—Every house should have a proper privy. Bored hole latrine for private use and deep trench latrines for public use serve the purpose well.

Dry refuse may with advantage be used for reclaiming low lands. Night soil and other refuse may be disposed by incineration. Dead bodies to be disposed of in a proper place kept separately for the purpose.

(5) *Medical Arrangements*:—Should undertake both prophylactic measures against preventible diseases and curative treatment of the sick. Travelling dispensaries in charge of a medical officer should serve a useful purpose in giving medical relief and prophylactic inoculation during epidemics. Finally maternity child welfare work, antimalaria work etc. are also to be taken up by the rural health unit.

CHAPTER TWELVE

SOCIAL MEDICINE

Social medicine is a part of and not another name for preventive medicine which treats human being as a living social element forming a unit of society and concerns itself with the "study of man as a total individual" in all its aspects particularly in the interest of human well being. It provides a comprehensive approach to the understanding of Man and his relationship to his environment in health and disease. It bases the construction of "total health" as a concept of equilibrium which results from interaction of adoptive and disruptive forces within and without the organism.

Social medicine implies that health much more depends upon social and emotional environments than on medical measures alone. Thus it may be aptly quoted—"That health of the people depends primarily upon the social and environmental condition under which they live and work; upon security against fear and want, upon nutritional standard; upon educational facilities and upon facilities for exercise and leisure." In every illness it is always the personality as a whole that reacts in its social, emotional, and environmental aspects. The personality, home back ground; familial constellation, cultural patterns etc. are factors which are seldom taken into consideration during medical treatment. The reactions and behaviour of the patient however psycho-neurotic it may seem to us, is in essence a reaction to some conflict or fear motivated largely by subconscious psychological process of which the patient may even be wholly unaware. Just as Medical Men, we concentrate upon medical aspect of the disease a social worker trained in social medicine would concentrate on the psychological aspect of the illness. A department of social medicine can thus serve as a useful unit to any hospital like the E.N.T; Eye; Chest; X-Ray deptt. etc. to enhance the value of medical care and maintenance of "total health." A social worker trained in understanding the human behaviour and technique of interviewing can by "case work technique" help the patient to realise and express the reasons of his feeling to hospital treatment. Thus he gets the opportunity for expressing his repressed feeling particularly during "home visits" by the social worker which often helps the patient to

relieve his anxiety and provide a sense of support. Social medicine has arisen to fill the gaps in the application of complete medical treatment.

The socio-economic factors of illness can be studied and treated by medical men with the help of social workers. Adverse social conditions, environmental maladjustments cause disturbances of the activity and function of the body and be subgrouped under social medicine as social physiology; social pathology and so on. Social and psychological components involved in an illness cannot be ignored. Reaction of these type often baffle the best attempts of the attending doctor; parents may refuse to agree to a surgical operation for her child even when it is the only method of cure; Tuberculosis patients may refuse to undergo sanatorium treatment; A patient may go away from hospital on risk bond against medical advice etc. In such cases comes the place of professional social worker to find out the underlying causes of their peculiar reactions. Social worker can help the patient to realise and express the reason of his antipathy to hospital treatment particularly during "home visits."

The factors are too numerous to classify. The patients themselves are not always conscious of the factors that create these fears and complexes in them. Unless these are handled scientifically the patients would remain emotionally upset and unable to accept the full value of prescribed treatment. Many patients again suffer from physical symptoms which may not necessarily have an organic basis or which may have both organic and emotional basis. So a knowledge of physical and social environment and emotional reaction have been found invaluable in interpreting some causative factors. Social factors thus need tackling in taking proper care of the sick.

The study of social medicine provides us with that knowledge. It also teaches us an approach to the "patient as a whole" and presents to us the conception of convergence of several causes besides the physical one only. "Health represents the phase of adjustment and disease the phase of failure." "When a stimulas is encountered the organism must deal with it regardless of its source (external:—Internal:—emotional—). If the capacity of the organism to deal with the stimulas is adequate no disruption of equilibrium occurs and a state of health persists: If the stimulus cannot be dealt with we recognise it as a stress which now upsets the previous balance and disease is the consequence." Social medicine

would help us to do away with the forces of maladjustment and disruption; A trained social worker can bring to light significant factors by a planned interview and sympathetic discussion of his problems. A social worker can also keep in touch with the patient and his family and try to remove obstacles in carrying out the treatment and help to solve the complications in domestic relationship and help the family to adopt itself to the new situation caused by the illness. Rehabilitation of homeless sick persons; improvement of his existing conditions of environments, readjustment to his home and surroundings; school life or professional work all come under the purview of social medicine.

Finally a social worker can follow a case after discharge from the hospital and help in his after care, and rehabilitation. He can also help to acquire financial aid when required for the patients as this department keeps in touch with charitable trusts and Institutions unknown to doctors and the patients.

The study of social medicine would acquaint us with "hygienic socio-economic factors"—in the causation of illness and the necessary remedial measures to counter act these. The social service in United Kingdom is more or less organised. Its main components are as follows. (i) community service—education; (ii) public health service. (iii) Lunacy and mental deficiency service. (iv) Social Insurance. (v) Unemployment Insurance. (vi) Health Insurance. (vii) Widow, orphan and old age contributory pension scheme. (viii) Unemployment assistance—unemployment and disablement benefit. (ix) Sickness benefit. (x) Maternity grant. (xi) Industrial Injury benefit. (xii) Death Grant.

To summarise social medicine helps us:—

(i) To study and evaluate the social and emotional factors which reveal a patients willingness to accept the diagnosis and his ability and capacity to undergo the prescribed treatment.

(ii) To deal with those social and psychological factors which contribute to a patients resistance to the recommendation of the physician or interfere with the patients gaining full benefit from medical care.

(iii) To interpret significant social and psychological factors involved in a patients illness for joint planning of medical and social care.

To quote Dr. Ryle (Professor of Social Medicine, University of Oxford) "social medicine means the tracking down of the essential causes of the vast amount of illness, debility, malnutrition, mental disturbance and other "functional" disorders, in which there is no evidence of organic disease, but which are frequently its precursors, and which in themselves contribute largely to national inefficiency, loss of work, general unfitness and the making of class "3" population.'

Again he says "good food and habits of feeding, good houses, better facilities for open air activities and cleanliness, better education and cultural opportunity, holidays and social security could they be extended to the populace as a whole—would bring benefits both human and economic to the individual and to the state, beside which those accruing from all our remarkable advances in Remedial medicine and surgery of the last century, valuable though they have been, and must remain, would make a poor showing".

UNIVERSITY QUESTION PAPERS

1945

1. What arrangements are obligatory on the sanitary authorities controlling a place of pilgrimage for the maintenance of health and prevention of epidemic diseases?
2. Enumerate the different methods of disposal of night soil for a village in Bengal. Describe in detail the method you prefer.
3. Why it is necessary to take balanced diet? Describe the various deficiency diseases.
4. How are gastro-intestinal diseases spread? How, would you prevent them?
5. Name the diseases that are likely to break out as an aftermath of flood, stating reasons. What measures would you take to prevent them?
6. What are the different methods of disposal of dry refuse? Describe in detail the method you would recommend for a small municipality?
7. What do you understand by pasteurisation of milk? What changes take place in the process of pasteurisation? What are the objections to feed children solely on pasteurised milk?
8. What do you understand by "concurrent" and "terminal disinfection"? How would you disinfect the following articles:—
   (a) Silk garments.
   (b) Books.
   (c) Leather goods.
   (d) Coir mattress.
   (e) Feeding Cup.
9. Describe the methods of prevention of malaria in a rural area.
10. Describe in detail the causes of discomfort felt by persons living in an ill ventilated over crowded room.

1946.

1. What is meant by the term "Health"? Describe the effect of exercise on human body. Draw up the charts assessing the caloric value (a) for a man with active exercise (b) a man of sedentary habits.

2. What do you know of various immunobiological methods of control of spread of communicable diseases?
3. After a general disturbance in the country it is considered necessary to move a large body of refugees to camps in (a) town and (b) country side. What essential preparations are necessary to maintain health and prevent outbreaks of epidemic and non-epidemic diseases in such camps.
4. What are the factors concerned in spread of malaria in a community? Describe briefly how you will deal with those factors in the control of the disease.
5. Describe the principles of purification and supply of water to a large community.
6. There is at present a mild epidemic of cholera in Calcutta. What temporary and permanent measures are to be taken in order to prevent its spread and future recurrence?
7. If an adult citizen of Calcutta is supplied with twelve ounces of rice per day and if he does moderate amount of manual work, what other foods should he take and in what quantity to get the required calories and to make the diet a balanced one.
8. Describe the different type of reactions that may occur after revaccination mentioning the significance of each.
9. Compare the working of "slow sand" method of purification of water with that of "Rapid or mechanical method."
10. Name the different available methods of disposal of sewage. Describe in detail the "Activated sludge process."

1947.

1. Compare the working of "slow sand filtration" with that of "Rapid or mechanical method" of purification of water.
2. Name the various methods available for disposal of sewage. Describe in detail the "Activated sludge process."
3. Discuss in detail why a man living in a crowded and illventilated room feels uncomfortable?
4. A number of cases of cholera have occurred in a Town of which you are in charge of health services. What measures would you take to prevent the spread of disease?
5. Describe in detail the various measures to be adopted to control malaria in a village.
6. Define vaccination and describe the course of eruption in primary vaccination. What is meant by immediate, accelerated and primary reaction in secondary vaccination.

7. How is malaria transmitted? State the measures you would take for its prevention in a rural area?
8. Describe briefly how would you carry out a malaria survey of a moderate sized village in Bengal.
9. Write short notes on the following:—
   (a) Infant mortality rate.
   (b) Exhaust ventilation and its uses.
   (c) Splenic Index.
   (d) Specific death rate.
   (e) D.D.T. and its uses.
   (f) Schick test.
10. What should be the quality of water in a public protected water supply? How can this be achieved if the source of supply is a tank and the water is known to be muddy and polluted.
11. Outline the medical and sanitary arrangements you would make in a fair (mela) lasting one week and which will be attended by about one lakh persons.
12. You are in medical charge of a dormitory accommodating about one hundred school children. Three cases of diphtheria have occurred among the children in dormitory. What steps would you take to prevent the spread of the disease?
13. Outline briefly the public health organisation you would suggest for a municipality with a population of about one lakh.

1949.

1. Enumerate the fat soluble vitamins and the results of their deficiency on the human system. What are the effects of cooking and canning them?
2. Enumerate briefly how tuberculosis spreads among human beings and suggest measures for control of the disease in a medium sized town.
3. Write short notes on the following:—
   (a) Bored hole latrine.
   (b) Saturated steam.
   (c) Milk injury.
   (d) Droplet infection.
   (e) Maternal mortality.
   (f) Night soil trenching ground.
   (g) Antenatal clinic.
   (h) Balanced System of Ventilation.

4. What are the various methods of purification of water on a larger scale? What measures would you adopt for the protection of water supplies?
5. What diseases spread through drinking water? Describe a method of purification of water drawn from a river for the supply of a town.
6. Enumerate the different biological methods of disposal of sewage. Describe one method in detail.
7. What is balanced diet? Draw up a daily chart of a balanced diet for the people of this province. Is the average Bengali diet deficient in any respect?
8. Describe the public health organisation in Bengal as briefly as possible.
9. What is the primary object of purification of water? What is meant by "Mills Reincke Phenomena"? What happens if water is stored for a long time in a big tank? Describe briefly the methods of purification of water by chlorination.
10. Explain what you mean by (a) Hard water and (b) soft water?What is meant by permanent hardness of water? What do you understand by the "Base exchange method" of softening water.
11. What is septic tank? Describe briefly its action.
12. Write short notes on the following:—
    (a) Conservancy.
    (b) Scavenging.
    (c) One pipe system.
    (d) Traps (in connection with house drainage).
    (e) Pasteurisation of milk.
    (f) Composting.
13. What is meant by "Rationing of food"?When and why was the system introduced in Calcutta? What articles of diet are usually supplied to an adult person weekly and in what quantity?
14. What is the importance of child welfare centre? What measures would you take for the protection of motherhood?
15. In drawing up a scheme for the improvement of the sanitation of a Bengal village what points would you look to?
16. What precautionary advice would you give to an intending pilgrim before he proceeds with his family to a big mela like Jagannath car festival at Puri or Kumbha at Allahabad.

1950.

1. Describe an ideal well. How are wells in rural areas usually contaminated? Give precisely what you would do in disinfecting a well. What tests would you make to ensure that the well water is thoroughly disinfected?
2. What is activated sludge? Describe very briefly the various main stages and the action in each stage of the sewage disposal by this process.
3. What are deficiency diseases? Name the diseases and the deficiency of the particular food factor that causes the disease in each case.
4. What is a food calorie? For an upper middle class family consisting of three members one of whom is a boy of 14, suggest a diet which will meet their food requirements and show the total calories by actual calculation. Dietary articles to be selected from what is ordinarily available in the West Bengal market.
5. You have been sent in charge of a festival camp where usually 50,000 to 100,000 people collect annually for about a month. Give briefly the health and sanitation of the camp.
6. What are virus diseases? Name them. Mention the main preventive measures you would adopt against the spread of the most important among them according to your opinion.

   Write short notes on:—

   (i) Larvicide.

   (ii) Saturated steam.

   (iii) Standardised death rate.

   (iv) D. D. T.

7. Compare the merits and demerits of slow sand filtration and rapid filtration of water supply to a big city.
8. What are the essential points to be taken into consideration in "Hygienic disposal of excreta"? Describe one of the methods of hygienic disposal suitable for a scattered rural contamination.
9. How does ground water differ from surface water in quality? What precautions would you recommend to ensure that the surface water supplied to a community is free from contamination.
10. What are the proximate principles of food? What are the functions of vitamins?
11. Describe the life history of Necator Americanus. Discuss the value of this knowledge in preventive health work.

12. How would you diagnose a case of small pox? Describe the steps you would take to deal with an outbreak of the disease.

13. What are the activities of the school health programme? Outline the procedures you would adopt in health education in schools.

14. Describe how bleaching powder and potassium permanganate are used for disinfection of water. Compare the merits of the two.

15. Write short notes on:—

(i) Paludrine.
(ii) Exhaust ventilation.
(iii) Carrier.
(iv) Infant mortality rate.

16. Discuss the factors you will take into account in assessing the healthiness of a house.

1951.

1. What is a shallow well and what is the danger of using it as a source of water supply for drinking purposes? How may this danger be lessened and in what way can the source of pollution be ascertained?

2. What mainly constitutes "hardness" in water? How excessive hardness be removed for domestic purposes? What may be the effects of very hard water on (a) Individuals, (b) Industries?

3. What is meant by (a) Infant mortality, (b) Maternal mortality? How are they expressed as rates? What measures would you adopt in a town of 100,000 population with a view to the reduction of these mortality rates?

4. In the case of a patient suffering from Typhoid fever and nursed at home in a village, describe fully the steps you would adopt to prevent the spread of the disease.

5. What is meant by active and passive immunity? Mention the communicable diseases in the control of which one or the other is used, stating in each case the nature of the substance used and the kind of immunity conferred.

Or, What is meant by "deficiency diseases"? Give examples, stating in the case of each the best means of prevention.

6. Describe briefly any one method of pasteurisation of milk and denote what effects this process has on the quality of the milk.

7. What is the difference between an antiseptic and disinfectant. In selecting a liquid disinfectant what essential points you will bear in mind

8, Write short notes on:—

(i) Larvicide, (ii) Health Visitor, (iii) Katadyn process, (iv) Compost.

Or, What is standardised death rate? Describe how it is computed.

1952.

1. How does a shallow well differ from a deep well? A well is suspected to have been contaminated with cholera dejecta. What will you do to purify it?
2. What is the composition of air and how is its uniformity maintained? Describe very briefly the changes which take place in the atmosphere due to human occupation.
3. What is meant by "Offensive Trades"? Name such trades which are common in this country.
4. What is meant by "Balanced Diet"? What in your opinion should be the standard diet of an adult Bengalee.

Or, What is the composition of Pure cow's milk? Mention the diseases conveyed by Milk.

5. Name the different methods of "Disposal of Refuse". Describe the method which in your opinion will be best suited for a small municipal town with a population of 10,000.
6. Describe briefly the preventive measures you would adopt to check the spread of "Pulmonary Tuberculosis."
7. What are the diseases carried by the common "House Fly"? What measures would you adopt to prevent its breeding.

Or, Describe briefly the method of disposal of night soil by trenching.

8. Write short notes on:—

(a) Density of Population. (b) Infantile mortality rate. (c) Incubation period. (d) Damp-proof course.

9. Describe briefly a slow sand filter for water purification and its operation.
10. What do you understand by terminal disinfection? Under what circumstances would you consider this necessary? How would you carry out concurrent disinfection in a case of typhoid patient in a middle class Bengali family.
11. Name the principal food factors and give lists of common articles of food in Bengal which are specially rich in each of them.

Or, what damage to health may be suffered by workers engaged in a dusty establishment such as stone dressing or grinding? How would you prevent such damage?

12. Describe how plague is transmitted and how its spread may be prevented in a small town.

Or, what measures will you adopt to reduce the incidence of Leprosy in a town?

13. How would you ensure adequate ventilation in a class room in a Bengal town and how would you satisfy that adequate ventilation has been effected?

14. Give briefly the life history of mosquito. Name the diseases carried by this insect.

15. Describe the method of vaccination against Small Pox. How would you interpret different types of reactions.

16. Write short notes on the following:—

(a) Diphtheria carrier. (b) Sub-clinical infection. (c) Pre-natal care. (d) Quarantine.

1953.

1. Describe the life cycle of Ankytostoma duodenale.

Or. How would you organise and conduct a campaign against hookworm in a rural area of Bengal?

2. What points would you consider in the construction of a well used for supply of drinking water.

3. What is the composition of cow's milk? Discuss its value as a diet of a man.

4. What do you understand by "Industrial Hazards". How are these classified?

5. How would you control an epidemic of cholera in a village of 1000 people?

6. What is active immunization? Name the diseases in which active immunization is of value.

Or, Name the diseases caused by vitamin deficiency. What steps would you adopt for controlling any one of them?

7. What is the relation between overcrowding and disease? How is over crowding prevented in a theatre?

8. Write short notes on:—

(a) Social medicine. (b) Personal hygiene. (c) Isolation. (d) Physical disinfectants.

9. What is B.C.G. vaccine? How is it used? What is the nature and duration of immunity conferred by it?

Or, How is malaria classified? Name some of the most and least malarious areas in India.

10. What is droplet infection? Outline briefly the general principles of control of these infections.
11. Define "safe water supply". How may river water be rendered safe for public supply? What standards of safety are prescribed?
12. How does continued exposure to the following affect the health of industrial workers:—
    (a) high temperature. (b) high atmospheric pressure. (c) dusts.
13. Discuss the role of vitamins and proteins in resistance to infectious diseases.

Or, Give a classified list of animal reservoirs of human infections. Briefly describe the mode of transmission of infection to man in each case.

14. What is a Sanitary Latrine? Describe the construction of any simple type you know. What are its advantages?
15. Name six important chemical disinfectants in use in public health work. State how they are used and the purpose for which they are used.
16. The infant mortality rate is said to be high in India. What are the causes? What are the remedies?

1954.

1. Define "hardness" of water. How would you get rid of it in a large scale drinking water supply?
2. How would you sanitate a water-logged village with latrines suitable for the condition of the soil? Briefly describe the type you would suggest.

Or, What are the important elements of a Sanitary Latrine for rural areas? Describe the element you consider most important.

3. What dusty trades ordinarily endanger the life of the workers? What diseases do they cause? What broad preventive measures would you adopt?

Or, How would you proceed to investigate an outbreak of "food poisoning" amongst students in a Calcutta Hotel?

4. Write short notes on'—
    (a) Composting; (b) Residual spray of D.D.T.; (c) Permutit.
5. How does plague ordinarily occur in human beings? What control measures would you adopt in a small municipal town?

6. (a) What are the common gaseous disinfactants used?
   (b) How would you disinfect the following:—
   (i) Hospital mattresses and clothings, (ii) Leather (iii) Well water, (iv) Typhoid stool.
7. How does hookworm infection occur and spread? How will you control the spread of the disease in rural areas?
8. Define "Maternal mortality". How do you calculate maternal death rate? What broad measures do you adopt for its reduction?
8. Compare the merits and demerits of "Slow sand" and mechanical filtration of water.
10. What general provisions would you lay down for ensuring health and welfare of Industrial workers? What specific provisions should you make for women workers?
11. In a place of pilgrimage where about 100,000 people gather annually for about 2 months what arrangements will you make both temporary and permanent in order to maintain and ensure health of the area?
12. What do you understand by the term "Social Medicine"? In what diseases do the social components play an important part? Suggest some remedies in respect of any one of them.
13. You have been called to a case of typhoid fever in a private house. Describe what specific steps you will take in regard to the patient as well as other members of the house for preventing further spread of the disease.
14. Why is School health work carried out? What are the main heads under which this work is carried out?
15. What is standardised death rate? How is it calculated?
16. What do you understand by "Health Education"? How will you carry it out in the rural areas of West Bengal?
17. Write short notes on : (a) Larvicide, (b) Carbolic Acid Coefficient, (c) Upland Surface water, (d) Flea Index, (e) B.C.G. Vaccination.
18. How is "Rabies" caused? Give a scheme for its control in a big town.

1955.

1. What different kinds of mineral and animal impurities are found in water used for drinking? What are their effects on health?
2. What are Vitamins? What deficiency diseases are caused by their absence in the diet? In what conditions is a supply of B1 indicated?
3. In a town of 100,000 population Tuberculosis death rate is .4 per 10,000 population. What measures will you adopt for control and prevention of the disease?

Or. How will you organise maternity and child welfare work in rural areas? What minimum staff will you provide? Indicate very generally their respective duties.

4. How does Plague occur in man? How will you investigate an outbreak of plague and what control measures will you adopt?

5. What is ;'Environmental Hygiene"? Describe a latrine you would suggest for rural areas in West Bengal.
